High Pressure Dam Gates

Large Fitting-Out Cranes

Engineering News-Record

November 14, 1918

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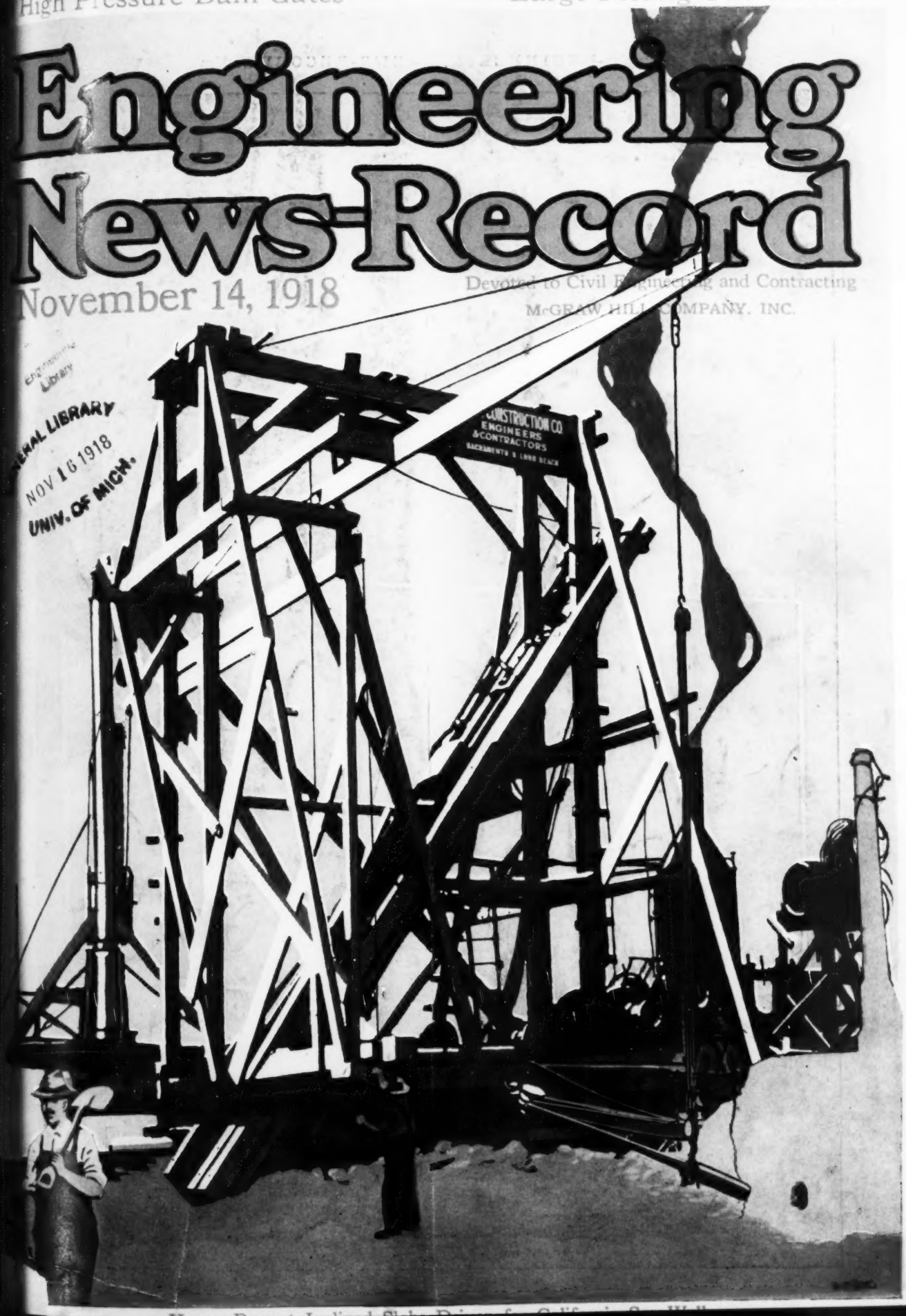

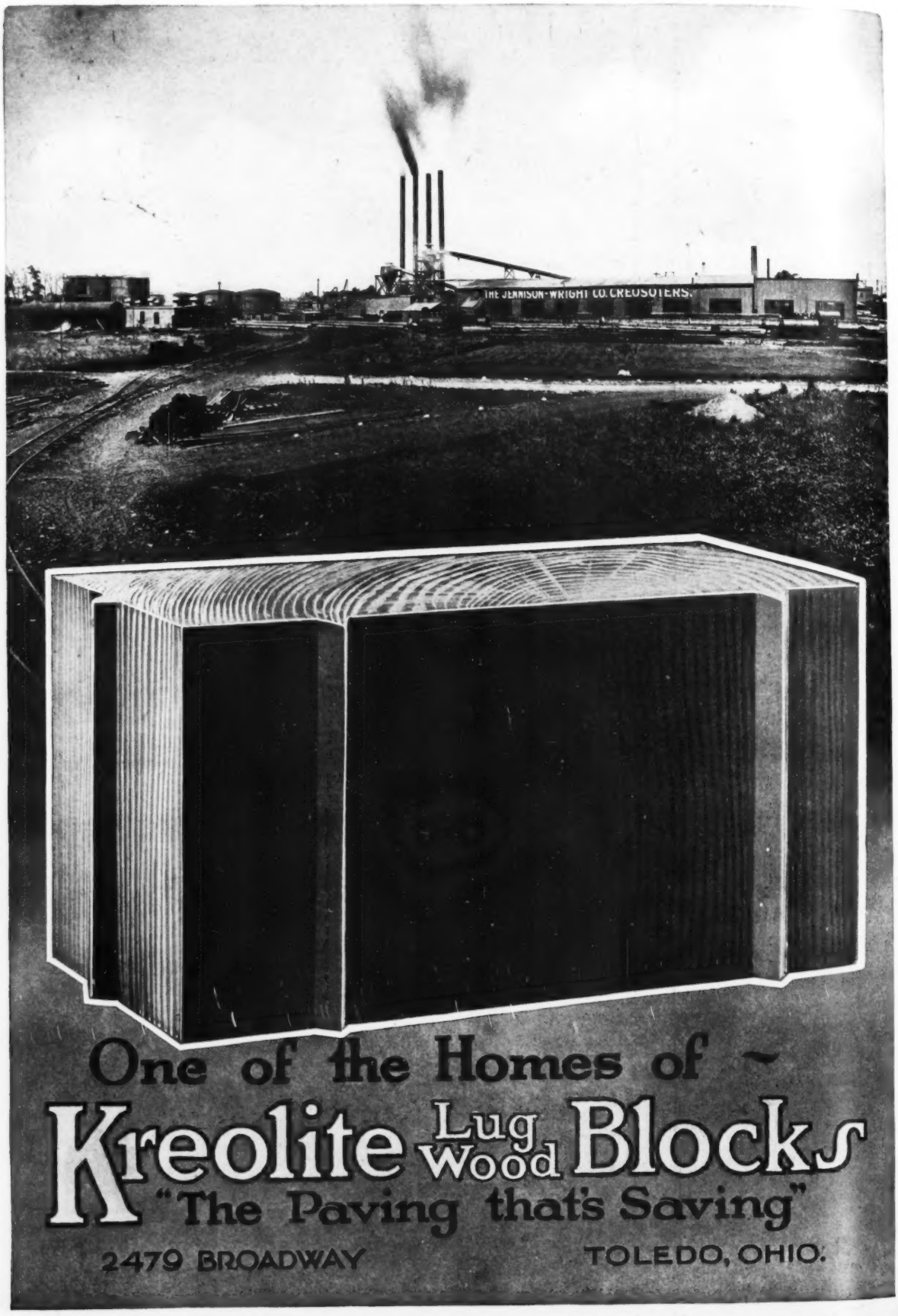
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CHARLES WHITING BAKER, *Consulting Editor*

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By D. W. Cole.

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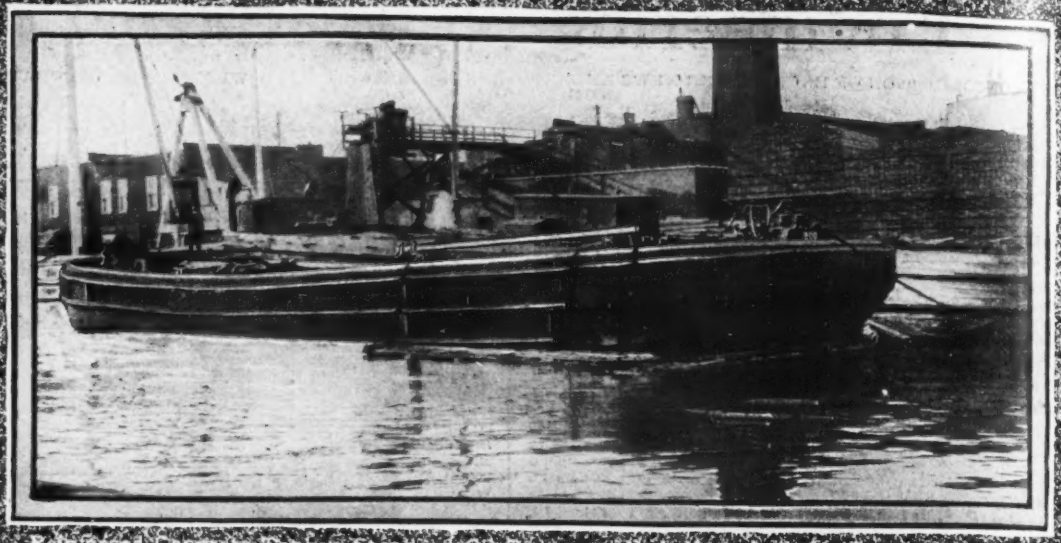

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor
CHARLES WHITING BAKER, Consulting Editor

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Peace

PEACE has come and the country has gone delirious with joy. The first jubilation, following a false report, did not dampen the enthusiasm for this week's celebration of the actual event. And well might we celebrate twice; the spectacle of a peace-loving people returning to the arts of peace after a terrible war is an event we shall not witness again. Yes, we pray that our children's children unto many generations shall not see such a day.

We are glad peace has come. It is here sooner than expected, but it is on our terms—unconditional surrender of the enemy, and the destruction of the autocratic power which caused the war. We have gained that for which we fought—the triumph of the democratic ideal, a purpose to which we had dedicated, if there were need, our last dollar and our last drop of blood.

What are the results of the conflict? What is the gain for the tremendous price the world had to pay?

International peace for a long time, possibly the elimination of war for conquest forever—that is, the first and greatest result. To expect such a gain would be chimerical were it not that we have destroyed the incubus that has led to war—the power of a single, unscrupulous individual or of a ruling clique to control a whole nation. The theory of the right of kings to enthrall a people, to use them as dupes, is dead forever. It passes with the execrated Hohenzollern line and with the memory of their unscrupulous accomplice, Bismarck. The autocracies of Germany, Austria and Russia have been cleansed from Europe, and what monarchies remain will vie with republics in their democracy.

This surely is gain.

France and England, as is to be expected, have gained more than we. They deserved more, for theirs has been the greater sacrifice. Both countries had been displaying distressing signs of decadence—the weakening of the moral fiber in every rank of life. They have been remade. The flabbiness has been burned out. The blindness that characterized their political life has given way to light. They have heavy reconstruction problems, social and economic rather than material, but their people see with the clarity of those who have suffered grievously and have been brought face to face with death.

Germany, too, though the horror of her crime is still too near us to treat her with sympathy, has gained much. She will have the opportunity to turn to arts of peace the talents which for fifty years have been subordinated to a military ideal. She will have an opportunity to establish herself as a civilized nation, and to remove the stigma of the Hun which now rightly is upon her. For this opportunity of setting herself at one with the civilized world she has had to pay a terrible price—but she can reckon it as clear gain.

As for ourselves, how shall we appraise our return? Our part in the war has been a brief one, too brief to indicate clearly the moral and social results. We have not been called on to make sacrifices to the extent of our European allies. We have not received a severe chastening. We do not belittle our casualties—the loss of even one life would be regrettable—but we have lived in comparative ease while other nations have suffered.

The one clear gain for us is the evidence that we are truly a nation, that Americanism means something, that it has sounded a common note in the breasts of the heterogeneous peoples who came to our shores, and has made them really one.

That new consciousness of our truly national character is heartening for the future. We shall have internal difficulties, but they shall pass and we shall work out a destiny commensurate with our already brilliant achievements, commensurate with the greatness of the resources of our country. Moreover, we have learned the lesson that we cannot afford to lag in the Americanization of those we receive into our midst. Never again can we tolerate the adherence to old-world sympathies that gave us cause to fear disturbances from Germans or citizens of German origin at the beginning of our entry into the war.

We are the gainers, too, in having acquired international sympathies. And that result has been reciprocal; Europe has a new and a better appreciation of our ideals and our mettle.

In social and economic ways we have much for which the war is accountable. Part of it, the major part, is progress and gain, but some of it is out of harmony with the individual initiative and freedom for development which is the basis of whatever progress this country has made. In England, where the lines are tightly drawn between employer and employee, there has been a chastening that favors a solution in which reason will prevail. Here there has been no chastening. The forces of labor, come recently to tremendous power, have not, as we see it, developed a sympathy for the conditions under which the employer labors. On the other hand, the employers have awakened to the need of more intelligent handling of the labor problem, despite the unreasonableness of labor so frequently displayed during the conflict. On the employer's part,

then, though there will not be quick forgetting of the unreasonableness, there will be a disposition to deal more openly and fairly in matters affecting the welfare of the worker. Nevertheless, we must look for trials and difficulties; what we have been spared by the early termination of the war, we shall in part at least suffer in the reconstruction. But bloodshed, happily, will be absent.

For our part in the war while we were in it, we may well feel satisfied. History may be less lenient with our delay in entering. Once in, we demonstrated that American initiative, American versatility, American virility, could be turned into war channels with no less success than into those of peace. We made mistakes, but the fault therein lies not so much in the making, as in the perversity of those who refused to admit the errors when pointed out and tried to discredit and punish those who disclosed them.

We must not forget, though, that while we were in at the finish, and performed a very necessary—an essential—part, the major part of the fighting and sacrifice have fallen on our allies. They have stood between us and the Hun, they have borne the brunt of battle, almost to the point of exhaustion. We have succored them only at the very end, when succor was sorely needed, it is true, but the battle has nevertheless been theirs. For this we can never be adequately grateful; the debt we can never repay.

So in this day of victory, while we give full praise to our own gallant sons, we will not forget what we owe to those millions of men of the British Empire, France and Italy who have laid down their lives for us no less than for their own lands.

In the hour of victory we salute them, the allied comrades in arms living in victory or triumphant in death, who have fought the good fight. They have made humanity their debtors. They have made the world "safe for democracy."

Highway Policies To Be Crystallized

THERE was assurance, even before this week of peace, that the highway convention under the joint auspices of the American Association of State Highway Officials and of the Highway Industries Association, set for Chicago, Dec. 11-12, was to be a most important event. But its importance has been immensely increased by the coming of peace. Under the war cloud there were problems enough, but enthusiasm for the future was necessarily subordinated to the grim work of war. Now, with peace at hand, we are faced with the need of determining our highway course for the great future that is dawning. It is just the sort of problems that are vital at the moment, too, that are set for discussion—broad questions of policy, such as Federal control and parcel-post-route developments, the underlying principle in laying out a state-trunk-road system, uniform motor-truck legislation, the requirements of the highways of tomorrow and the future national highway policy and plan. Moreover, as the convention will be under the auspices of the highway officials' association and following immediately on their annual meeting, attended from all parts of the country as a matter of administrative necessity, there is assured the presence of all the leading highway engineers and officials of the country. Added to that is the impetus which has been given to the post-war highway drive by the authorization of the big bond issues in Pennsylvania and Illinois. With peace here, with the call for a big highway program coming from all parts of the country, with the stage set at Chicago by the nation's highway officials for the discussion of the big problems and policies, no one who is actively engaged in highway work or concerned with highway transportation can afford to absent himself from the convention. It is not too much to predict that it will be epoch-making.

Who Will Follow These Good Examples?

SELDOM is engineering literature enriched with so interesting and valuable a sketch of the development of an important device as is given on p. 880 in the article on high-pressure gates in dams. The author's long and intimate connection with the development and use of these gates adds to the value of his discussion. From the relatively simple gates in the Sudbury dam to the hydraulically controlled balanced valves in the Arrowrock and other Reclamation Service dams has been a succession of long steps. As announced at the head of Mr. Cole's article, a supplementary paper, on experiences with large-capacity reservoir outlets, will be given in a later issue. The two contributions to the literature of engineering design and operation might well stimulate other engineers to prepare similar readable sketches of engineering progress in highly specialized fields.

Post-War Highway Drive Begins

PENNSYLVANIA and Illinois, both by heavy majorities, have approved their large highway bond issue proposals. Pennsylvania's was for $50,000,000 and Illinois' for $60,000,000. Thus do the people of two great commonwealths record their views on highway improvement. They consider good highways essential to their welfare and are glad to pay the bill.

The sentiment in Pennsylvania and in Illinois is merely that of the country at large. The people everywhere *will have* roads. In fact, they have thought more solidly than highway officialdom at Washington; they have sensed—even if as individuals they cannot make court proof of it—the essential nature of highway construction as a war, as well as a peace, measure. True, the bonds authorized in Pennsylvania and Illinois are to be sold only after peace is established, but the former strong highway sentiment has been immeasurably strengthened by the demonstration of the highway's service in war transportation.

There are rumors that even before these votes had been polled some members of the United States Highway Council had begun to see the light. We hope that the full effulgence will strike them now, and that while war-control continues some semblance of construction leadership will replace the past repressive policy.

It is too much of course to expect from Washington, either as a war or a peace measure, that strong type of leadership which befits one of the greatest constructive programs the country has ever known. The Federal

road administration has too long been in a subordinate capacity, lost in a department—that of Agriculture—whose main interests are foreign to road work. The time has clearly come for setting up a Federal agency commensurate with the highway future of this country—a commission with the autonomous standing of the Interstate Commerce Commission, the Federal Trade Commission or the Tariff Board. No other plan is adequate for the leadership which the Federal government should furnish in the tremendous highway development we face. The Pennsylvania and Illinois bond authorizations are but straws in the wind. A dozen or more other states will kick into the ring with issues ranging up to $50,000,000 in the next two years, while Congress, when the present Federal-aid period expires, will be thinking not in terms of $85,000,000 of aid but in half-billion allotments. And Congress will merely be harkening to the voices of the people—voices of which the Pennsylvania and Illinois expressions are but the first.

The first guns in the post-war highway drive have been fired—and to Pennsylvania and Illinois belongs the honor.

Greatest of Contractors' Meetings

NEXT week the general contractors of this country will assemble in Chicago for the most important meeting they have ever held—that for the organization of the National Association of General Contractors. It behooves every general contractor who can possibly attend to be there and to lend his support to the movement. He will receive much more than he can give. As a cold matter of business, he cannot afford to remain outside the organization.

Briefly, the object of the association, no matter what the actual wording of the constitution, is the stabilizing of the contracting business. If there is any industry in which the "competition of incompetence," the competition of the man who does not know what he is doing, has had more serious consequences we do not know what it is. It has defrauded the public, made hard sledding for legitimate contractors, and has resulted in the development of an attitude of suspicion on the part of the public that has caused grievous losses to the contractor, through contractual provisions lacking mutuality and imposing conditions that encouraged poor rather than good work.

The new organization will establish standards that will force the elimination of this type of business man—against whom the Federal Trade Commission has so strenuously objected, the type of man who, until he goes down in inevitable ruin, is a menace to the whole industry.

As to the detailed work of the association, it does not require much imagination to realize the large number of questions on which uniform practice is desirable and others in which the public, both private builders and Government agencies, city, state and Federal, needs enlightenment.

The wonder is that this organization has not come sooner. Now that the launching is at hand, no contractor of standing should be absent. If he cannot attend, his application should be there to swell the indorsement of this greatest movement in the contracting field.

A Call for Efficiency

A CALL has been sounded to combine efficiency with speed of production. It comes from the Shipping Board and is addressed to our shipbuilders. But the message goes with equal directness to all others engaged in the high-pressure activities on which the nation's power is concentrated. Speed has been attained. We may not slacken in rate of output. But the drive for speed alone must now be transformed into a drive for the full measure of efficiency compatible with fullest measure of output.

For nearly two years every man and every tool in the country have been engaged in producing at the highest possible rate. An undreamed-of production has been realized. Inevitably, in this drive all considerations were cast aside except that of speed. Cost—economy of effort and material—could not be thought of while the production machinery was being brought up to fullest performance. It was vital that every engine of production should be worked to its limit; if three men working to indifferent advantage could make the facilities at hand yield something more than could two men, or but one, the three were set to work. Top speed has been reached in this process. We are now at a stage where more can be accomplished if there is less waste, less inefficiency of effort.

Producers themselves, those who saw clearly, knew that consumption could not long continue at the same rate, and that sooner or later efficiency must again become dominant—certainly with the approach of post-war conditions. But even during the campaign for maximum output both man-power and material supply have proved to set limits to production. The time for return to efficiency is already at hand, it would seem; Mr. Hurley's call is the expression of this new purpose.

Scores of shipyards whose work is fully organized are even now engaged in rearrangement of their procedure to systematize production on a more efficient basis. The Shipping Board head now voices the need for a stronger and more general drive on efficiency in order to forward the ship program.

In the application of this call to each one of our present intensive production activities—not to shipbuilding alone—lies its broad importance. Each one, as it was speeded up, reached a limit of production not in floor space or in tool capacity but in organization and in supply. The next advance must be made through curtailment of losses, of inefficiencies.

That this will be a direct preparation for post-war industry is obvious, for if production then is not capable of meeting competition it may soon find itself halted. So much the more striking that the present call for efficiency arises from war needs alone. Out of the war service itself grows our preparation for the industrial future.

It may well be that in the years to come productive efficiency will command a premium far greater than before the war. The meaning of waste, known to us now by distant contemplation, is likely to impress itself unforgettably on all minds as we labor in the repair of that world-wide destruction. If that prove to be the case, the early impetus toward those higher demands for efficiency will surely be a lasting benefit to ourselves and to the world.

High-Pressure Gates in Dams for Water-Works and Irrigation Reviewed

From the Sluice Gates in the Sudbury Dam of the Boston Water-Works Through the Various Stages of Gate Development in the High Dams of the United States Reclamation Service

By D. W. Cole
Senior Engineer, United States Reclamation Service, Boise, Idaho

Originally presented at an Idaho conference of engineers early in 1918, this paper has been in such constant and increasing demand by engineers who have heard of it that the author decided to make it available to the entire engineering profession. It will be followed by a supplementary but independent résumé of experiences with irrigation reservoir outlets of large capacity, by James M. Gaylord, electrical engineer, United States Reclamation Service.—Editor.

THE control and regulation of large streams of water through gates and conduits under high pressure is an art of recent development. Ancient hydraulicians were able to accomplish within their limitations some remarkable control of water both in small and large quantities by means of dams, sluices, canals and conduits, all operated under low heads. But the development of modern mechanics and particularly modern machines and materials of construction had to be awaited before extensive regulation of water at high velocities under pressure heads of 50 ft. and upwards could be undertaken.

During the past fifty years, pressure pipes and gates have reached a high stage of development in city water-works practice. Such works brought about the use of two principal types of valves or gates, one being the bronze-mounted cast-iron circular gate, both of the single and double disk form, which is commonly used in all large cities, up to 48 in. and occasionally as high as 72 in. in diameter, for pipe lines carrying pressures ordinarily from 50 to 200 lb. per square inch. The other type, used chiefly for deep reservoir regulation, is the rectangular sluice gate of varying dimensions, up to 4 x 8 ft., usually fitted with bronze bearing seats both on the gate frame and on the gate leaf.

Power-plant and irrigation installations began about where municipal practice left off, both in circular conduit gates and in sluice-gate construction. Where sluice gates were necessarily of larger capacity, they were commonly required to operate under less head, and this led to the invention of the Tainter or radial pressure type of gate for sluiceways up to about 12 x 12 ft., while the Stoney or roller-bearing type was designed for very large sluiceways under both high and low heads. In pressure pipe lines a more limited variety of valves has been employed, usually starting with the typical city water-works gate built to standard patterns by a number of manufacturers, and leading, in the most advanced practice, to valves of which the Johnson balanced hydraulic valve is a type of recent invention.

It has remained, however, for irrigation reservoir outlet practice to develop perhaps the greatest variety

GATE-VALVE DISCHARGE FROM WORLD'S HIGHEST DAM AT ARROWROCK, IDAHO, ON THE BOISE PROJECT OF THE UNITED STATES RECLAMATION SERVICE

Ten 58-inch balanced valves operating under 105 foot head, each discharging about 1000 second-feet of water which then falls about 150 feet to the river bed. About 90 feet below there is a similar set of valves and at the river bed there is a set of rectangular sluice gates for operation under low head to draw off water to the reservoir bottom. The Arrowrock Dam has a maximum height of 348 feet from its lowest foundation point to its crest, or 354 feet to the top of the parapet walls.

of effort to control water in very large quantities and under high pressure. Up to the time of beginning such work by the United States Reclamation Service, about 12 years ago, it had been feasible in municipal works, and even for power plants, either to limit the head on the gates and secure the volume of required delivery by means of multiple gates discharging at intervals of elevation through outlet towers from the reservoir, or to limit working pressures and velocities in pipe lines and secure a balancing of head by means of bypasses around the large valves, so that it was not a necessary practice to carry water through such valves with unbalanced head or in large quantities discharging into open air.

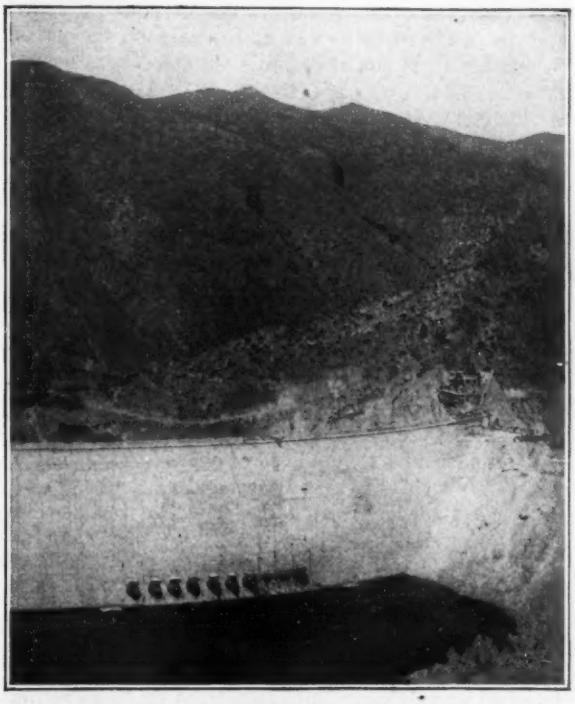
One of the most difficult problems encountered by the Reclamation Service in all its work has been the development of efficient and safe high-pressure gates with their operating mechanism. The entire problem was precipitated suddenly in the beginning when it was realized that relatively much greater quantities of water were required for irrigation, and must be regulated through larger outlets from deeper reservoirs, than had ever been attempted. Illustrating this point, it may be noted that the largest city water-supply conduit in the world, the new Catskill Aqueduct for New York City, with a daily capacity of 500,000,000 gal., a tube 17 ft. in diameter and nearly 100 miles long, has only about one-third the water-carrying capacity of one of the large Reclamation Service project main canals, such as the Boise Canal. In order to get the water out of deep reservoirs in the lavish quantity required for irrigation it devolved upon the Reclamation Service to devise large-capacity gates, which may be operated under 200-ft. heads, or practically four times the head commonly dealt with in the largest municipal storage reservoirs.

Sudbury and Wachusett Experiences

To enumerate a few of the typical difficulties in high-pressure gate practice we may begin with the Sudbury reservoir of the Boston water-works, where 3 x 5 ft. sluice gates were operated under 65-ft. head. I had the privilege of installing this battery of nine gates, and, knowing that the job was done in the very best manner, I was much concerned some years later to learn that there had been serious erosion, or disintegration, of the handsome cut-stone sluiceways below the gates, and dangerous pitting of the cast-iron gate frames, resulting from discharging even the moderate quantities of water required for little old Boston under this pressure, which 26 years ago was recognized as about the limit for that sort of installation. Recently this gate system has been entirely changed so as to utilize the energy of the discharged water in power development instead of permitting it to waste its force in the erosion of that excellent cut-stone and iron work.

About the same time, in the Croton reservoir outlets for New York City the engineers were encountering difficulties and serious wear and tear in the cast-iron gates of the new gatehouse for supplying both the old and the new Croton aqueducts.

A little later, in fact about a dozen years ago, the standard heavy form of cast-iron, bronze-fitted, pipe valves having been installed in the Wachusett Dam, which at that time was up to the minute in engineering



LOOKING DOWNSTREAM THE UPPER SET OF ARROW-ROCK GATE VALVES MAY BE SEEN
The last line of the valves was being installed when this view was taken

science, it was found that under variable head, up to 81-ft. maximum, there was damaging vibration in the 24-in. valves, either partially or fully opened, when discharging freely into larger open pipes below the dam. The chief engineer reported that "while this method of controlling the flow was in operation there was a constant jar and loud noise in the building and the effect upon the piping was rather serious. The lead was jarred out of several joints, brick and concrete piers supporting the pipes were cracked and shattered, nuts were jarred off of bolts with which the pipe flanges were bolted, and some of the bolts were broken." Examination disclosed pitting and wear of the pipes below the gates to a depth of ¾-in. into the solid cast iron. Replacement had to be made and regulation of discharge in this manner was necessarily abandoned, with substitution of operating the gates in series one above the other, with the head on each limited to 33 ft., at which pressure there has been no further difficulty.

High Dams of Reclamation Service

An instance showing the infeasibility of operating standard circular pipe gates under high head, with free discharge at a velocity of 120 ft. a second, was exhibited at the Shoshone Dam of the Reclamation Service, where 30-in. gates at the outlet end of 42-in. pipes through the dam were operated for a short period under the full reservoir head of about 230 ft. These pipe-line valves were of standard, double-disk, heavy, bronze-mounted, cast-iron construction, thoroughly well made according to city water-works specifications by an established manufacturer. It was planned to use them always either wide open or fully closed so as to avoid the severe vibrations when they were operated partly open, but it

was found that even in the process of opening these valves to full bore there was such strain on the parts as would put them out of commission, and it was necessary to abandon their use entirely.

At the Roosevelt Dam in Arizona the first attempt at control gates was in the form of specially designed and well-constructed Stoney type of roller-bearing sluice gates mounted after careful planning and attention to details of installation. But here again, under heads of less than full reservoir, there developed serious vibrations and damage to the outlet tunnels, which necessitated abandonment of this method of primary control. Circular hydraulic balanced valves were afterwards substituted.

Installations a little later were those of the Pathfinder and Shoshone Dams, where an extra heavy, special design of sliding rectangular sluice gate was put in to be operated under a maximum head of about 220 ft. These gates were provided with a heavy and efficient type of hydraulic cylinder operating device. The installation at Pathfinder was found to work successfully under full pressure, but the results on the tunnel lining below the gates were disastrous, owing to the tremendous vibration, which broke the fastenings and tore off the steel lining plates of the tunnel, and attacked the granite bedrock in the abutment of the dam through which the tunnel was driven. Attempts were made to reline the tunnel and reinforce the points of weakness, but the damage was repeated, and it was finally decided to install a different type of outlet control. Only minor damage was done to the Shoshone installation of identical construction, but here, too, changes were made in the methods of control.

ARROWROCK VALVES ARE OPERATED FROM GALLERY

One man, by manipulating hand wheels which control reservoir pressure in 4-inch pipes can, within 10 minutes, open or close one or all of the 58-inch hydraulically-operated valves shown in the preceding views

Experience with these Wyoming reservoir gates developed a feature of such work which had not previously been much understood or provided for in outlet regulation, and it was thereby realized that it was one problem to impound a lot of water in a deep prison and quite another and more difficult problem to let go of it safely when you wanted to. This special feature was the powerful suction effect of huge jets of water issuing from such gates and producing a partial vacuum surrounding the jets, which set up almost irresistible pulsations of air, alternating with overwhelming shocks of water, in any restricted passage below the gates. If the confinement of the water is complete on all sides of the conduit below the gate, then the result is a pitting, disintegrating or raveling of materials of the ajutage, whether of cast iron or stone, in a manner similar to that experienced in high-head turbine installations where the metal parts are eaten away at points subjected to vacuum effect. It is now believed that much of the pitting or honeycombing and wear and tear on gate castings, pipes, and granite walls, and such phenomena observed in the Eastern water-works dams, were induced by this suction or vacuum effect, rather than by the impact of water jets as was at first supposed.

Difficulties with the several standard types of gates gave rise to many suggestions and trials of new types. Among these was the hydraulically-balanced cylindrical gate or valve installed in the Lahontan Dam of the United States Reclamation Service. This operates under a maximum head of about 100 ft. A gate of almost identical design was adopted at about the same time for use in the Panama Canal locks, operating under 60-ft. head. With some modifications, the same type was adopted for the Sherburne Lake reservoir in Montana and the Lake Keechelus reservoir in Washington.

Essentially the design is a cast-iron cylinder (8½ ft. in diameter at Lahontan), open top and bottom, suspended by a stem from the top of the gatehouse and enclosed in a hood or dome which is supported on legs as high as the stroke of the cylinder valve and submerged in the bottom of the gate chamber. The water, admitted through guard gates and standing at reservoir level in the gate chamber, is retained therein, or its discharge regulated, by the cylinder, which in effect is a plug movable up and down within its hood, with small peripheral clearance, and seating on its circumference against the bell-mouthed opening forming the bottom of the chamber at the head of the outlet conduit. The pressure of the water acting diametrally on the periphery of the cylinder, or plug, is balanced and when the plug is raised the water escapes underneath it and falls into the bell-mouthed outlet after dissipating its jetting energy by the converging impact of its particles. With the cylinder plug hydraulically balanced in this manner there is no sliding friction on gate seats as in rectangular vertical gates, hence the only resistance encountered in opening and closing is the weight of the cylinder with its attachments independently of the head of water against it.

A simple type of high-pressure reservoir gate was designed for the Oakley Dam, Idaho, consisting merely of an open cylinder movable up and down in the gate chamber opposite inlet ports—almost like a circular slide valve in a steam engine. In this case, with the valve at any opening, the water jets into the chamber from all sides of the gate tower through these ports and then falls to a water cushion in the bottom of the chamber which discharges into the outlet conduit in the tunnel.

Quite a different type of balanced valve, known as the Ensign valve, was designed for the Reclamation

Service and, after trial in several of its dams, was perfected and installed in the Arrowrock Dam. This also is a cylindrical valve, placed horizontally, however, and moving into and out of a closed hood or case attached to the dam and submerged in the reservoir at the head of the outlet tubes 58 in. in diameter through the dam. The end of the movable cylinder protrudes into the outlet tube and terminates in a conical point to form a needle nozzle similar, on a large scale, to a standard needle valve in high-head impulse wheel control. In this case, the pressure of the water being balanced on all sides of the plug, there is no resistance to be overcome in the movement of the valve under pressure against a sliding seat. This valve, moreover, is ingeniously devised to operate by utilizing the reservoir hydrostatic pressure differential against the opposite ends of the plug.

In the common type of rectangular sliding gates under high pressure various compositions of bronze have been tried for relieving the tendency to scoring or abrasion of the surfaces of the gate seats. Modern practice has been reduced to using two compositions of bronze of different hardness for the two faces of the gate seats.

At the Sudbury Dam the old type of geared gate hoist, manually operated by crank or lever, was improved by the introduction of ball bearings, thereby reducing friction in revolving the nut on the main stem. This improvement has been generally adopted for geared gate hoists under any considerable pressure.

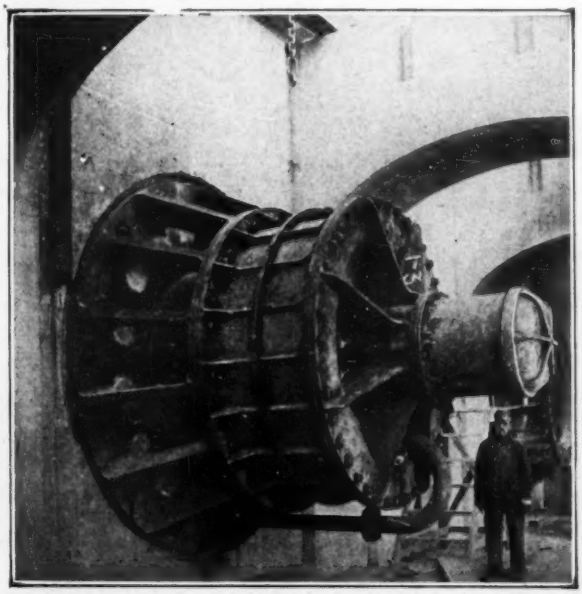
The Roosevelt Reservoir Stoney gate installation was one of the earlier plants to employ the oil pressure hydraulic cylinder for a jack, in lieu of gearing, to open and close the gates.

This device, built in a very rugged and perfect manner with bronze-lined cast-iron cylinders, brass piping, and electrically-operated pumps, was later worked out for the Pathfinder and the Shoshone high-pressure gates. The cylinders were made to operate up to 600 lb. per square inch with oil pumped by Gould triplex high-pressure pumps fitted with safety valves and automatic electric cutoff switches. The gate installation at Shoshone Dam was described and illustrated in *Engineering News* of Jan. 2, 1908, p. 8.

At the Lahontan Dam the set of 14 sliding and two balanced cylinder gates are operated by oil-pressure cylinders or jacks 16 in. in diameter and of a length equalling the stroke of the gate, varying from 2½ to 8 ft. The Deming triplex oil pump is belt-driven from an electric motor and works under pressure up to 400 lb. per square inch, controlled by pop valves, and under close observation by means of pressure gages both on the switchboard and on each cylinder. An overhead traveling crane in the gatehouse is available also for gate operation as well as for handling any heavy parts in the process of repair or replacement.

Air and vacuum effects, important phenomena which were not much taken account of in gate installations 15 or 20 years ago, have recently been dealt with in a way which promises to afford a means of relieving the vacuum disturbances due to cavitation in streams issuing around the obstructing valve supports.

Experience at the Roosevelt and Pathfinder Dams large streams issuing at very high velocities into a tunnel closed by the water below the gates so as to prevent entrance of air or admit it only in tremendous pulsations. In the Pathfinder case the disturbance was so violent as to shake the granite cliff abutment of the dam, produce thunderous noises, and its force was exhibited by the tearing out of heavy steel-plate tunnel lining and a general breakdown of parts around the gates. That the vacuum was responsible has been shown soon called attention to the powerful suction effects of



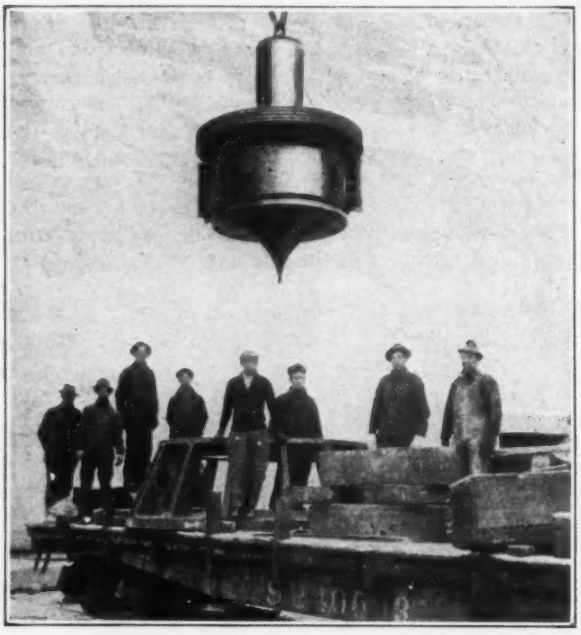
ONE OF THE LOWER SET OF 58-INCH VALVES IN THE ARROWROCK DAM

The piston is closed against the seat at the head of the 52-inch tube which extends through the dam

by the fact that these same gates may be operated singly or together so long as the tunnel below them is not sealed by the water, and, therefore, allows free entrance of air to the issuing jets.

At the Lahontan Dam the first definite and deliberate effort was made to provide air conduits leading from the atmosphere at the top of the gatehouse directly to the circumference of the outlet under the cylindrical valve where the issuing stream of water spouts into the outlet conduit. The importance of this air inlet was immediately shown when the gates were first operated and a powerful suction of air was induced down the 2 x 3-ft. air shaft. This air supply, while making considerable noise, yet serves to relieve the vibrations or pulsations of water which are encountered when this air flow is shut off and thereby compels indraft of air along the outlet conduit adversely to the flow of the water therein.

Likewise, at Lahontan, it was found that the partial vacuum induced within the hood of the balanced cylindrical valve must be overcome by admitting free air through a pipe into the dome of the hood. For this purpose a 12-in. spiral riveted standpipe, 100 ft. high, was placed, and when the gate is operating there is powerful suction of air through this pipe, which relieves the previously noted tendency for the valve to jerk or



A 58-INCH NEEDLE-PISTON FOR AN ARROWROCK VALVE

pulsate up and down according to the momentary intensity of the vacuum within the hood.

At the Arrowrock Dam, in the positive-control balanced valves which are operated at partly open stages, provision is made for inleting air around the needle nozzle, where the vacuum effect has in other installations produced pitting or corrosion of the metal parts. Experience seems to indicate that air admission to these critical points will cure the trouble.

At the Elephant Butte Reservoir air inlet passages were also provided, and the powerful suction in them was unhappily exhibited in 1917 when two men, one after the other, were drawn in against the opening and killed by the pressure; the probability being that one man passing along the inspection gallery first was pulled over against the opening and the other, in attempting to free him, completed the blocking of the passage, so that both were exposed to the full intensity of the draft. Their bodies could not be dislodged until the water gates were closed and the suction was stopped.

Power Plant Gates

A modern type of penstock valve is the Johnson valve, which is essentially a double-cone plunger, hydraulically balanced in an enlarged section of the penstock, or conduit, and is readily operated by a simple piping system utilizing the differential in conduit pressure above and below the plug. This valve has been successfully used under heads up to 164 ft. in the penstock. A description may be found in *Engineering Record*, June 13, 1914, p. 631.

Some of the recent immense power installations are developing extreme requirements in gates. For instance, a recent design for one of the Carolina plants includes a set of Stoney gates on roller-train bearings, operated by worm-gear electric drive. These gates are to be 16 x 18 ft. operated under a 102-ft. head, and the penstock is to be designed against a water hammer produced in stopping the flow of 5400 sec.-ft. in two seconds under 190-ft. head. These are prodigious figures to deal with, but apparently modern design, in the light of recent experience, will be able to solve these problems.

The extreme high-pressure hydraulic work encountered in the 1000- to 4000-ft.-head power plants employing impulse wheels is a unique class of practice, but in this the quantities of water are quite limited, and it becomes merely a question of making the moderate-sized pipes strong enough to withstand the pressure which is controlled by means of the well known and standardized needle valve. The problem of very large flow under high head, which is peculiarly the problem of irrigation reservoir practice, does not enter.

In all reservoir practice it is of prime importance to secure ample strength and extreme simplicity of gates and their operating devices. With important gates and parts entirely concealed, submerged and inaccessible, and with the vital necessity of being able at pleasure to empty or fill a reservoir or discharge any desired stream of water from it, it is of the utmost importance that the gate system should be adequate and as nearly fool-proof as possible.

Supplementing this fundamental requirement for strength and simplicity in deep-reservoir controlling apparatus, it must also be an accepted condition that the various mechanical devices, at their best, in deep reservoirs and large conduits under potentially destructive pressures, demand intelligent, careful and capable attention to keep them in working order.

Therefore, it is apparent that these important plants —for power, for irrigation, or for city water-supply— on which thousands of lives and millions in property are dependent, must be completely taken care by a class of skilled men trained for that purpose.

Precast Plates Form Shell of English Concrete Barge

In an experimental shipyard recently started in England with the coöperation of the Controller General of Merchant Shipbuilding, a new system of concrete barge construction is being utilized, in which the shell is formed of precast reinforced-concrete plates erected on the frames and tied together with interlocking reinforcement and poured concrete joints. When the plates are put in position, the extending bars in each plate are interwoven and locked around a pair of other bars in the intervening space. These bars form part of the reinforcement of a transverse frame extending along the bottom, up the sides and under the decks of the vessel. After the bottom and the side plates have been laid and secured in position, the reinforcement of the frame is assembled, and the main longitudinal reinforcement, consisting of 2-in. diameter bars, is fixed in place. When the reinforcement for the bulkheads and the center keelson has been similarly assembled and secured, everything is ready for the final operation of concreting, which is a comparatively simple matter, owing to the large proportion of precast work. The experimental ship which is being built is a 1000-ton tow barge.

Some Heavy Fitting-Out Cranes—I. Fixed Cranes at Kearny and Hog Island Yards

One Hundred-Ton Trolley Bridge Spanning Slipway Supplemented by Portal Cranes—Platform Derrick of Unusual Capacity and Reach Uses Single-Motor Hoisting Engine of Hell Gate Arch-Erection Plant

[Passed by Publication Approval Committee, Emergency Fleet Corporation]

HEAVY lifts at large reaches formed the main requirement for the cranes serving the fitting-out berths of the large shipyards carrying out the emergency shipbuilding program. After a hull is launched the interior fittings must be put in place, while the uncompleted ship is lying at a wharf-side or pier in the shipyard. Boilers and engines or steam turbines represent very heavy single weights, ranging as high as 60 or 80 tons maximum lift. In special cases other heavy weights must be provided for, which is the reason that led some of the yards to count on a maximum lift of 100 tons. To pick up such a load from the wharf or from a barge and lower it through a hatch on the center line of the ship requires a long reach. In some of the yards an extraordinary length of reach was specified so that the heavy members could be lifted from a barge lying on the far side of the ship, or so that two ships could lie abreast alongside the fitting-out wharf and equipment could be placed in either. The diverse solutions of this problem found at the various shipyards present features of most ingenious engineering in choice of type and detailing of the machines.

For the lighter service, locomotive cranes (preferably seated on gantry towers) are generally depended upon, as typically illustrated by the Hog Island fitting-out basin. The gantry substructure of these cranes brings the boom near to its working level, the deck of the ship. While a large number of light parts must be placed, only three or four heavy lifts are required for each ship. Therefore, the light cranes are arranged to move along the entire length of the fitting-out berth so as to reach any part of a ship's length and have access to all the ships lying along the wharf at a given time. For the heavy lifts, however, a single machine suffices, and some of the yards use a fixed crane, to which the ship is moved when the few parts in question are to be placed.

Radically different types of heavy-lift crane are found at the Kearny yard of the Federal Shipbuilding Co., the Hog Island yard of the American International Shipbuilding Corporation, the Bristol yard of the Merchant Shipbuilding Corporation, and the Newark Bay yard of the Submarine Boat Corporation. Data concerning them were made available through the courtesy of the officials of the yards, the manufacturers and the Emergency Fleet Corporation.

Crane Bridge Spans Ship at Hog Island

At the American International Shipbuilding Corporation's yard at Hog Island, Penn., the fitting-out berths in the wet basin are served by locomotive portal cranes, ordinary locomotive cranes, and a heavy crane bridge spanning the ship to deal with the few heavy lifts. The berths are connected with a number of railroad tracks and have a motor-truck driveway on each pier of the group constituting the berthing space. Like the hull-constructing part of the shipyard, the fitting-out basin is laid out for high capacity at all points, with a view to permitting intense concentration of work.

In a general way, the arrangement of the fitting-out basin may be understood from the sketch in Fig. 1, a plan of part of the basin. Seven piers, each 1000 ft. long by 100 ft. wide, spaced 266 ft. in the clear, and the adjoining wharf afford sufficient space for laying up 30 of the largest ships to be built at the yard. Back of the piers the wharfage space behind the bulkhead wall carries a belt of railroad-supply tracks connected by spurs with a series of warehouses. Turnouts from the main lead of these wharf tracks connect with tracks running down the individual piers.

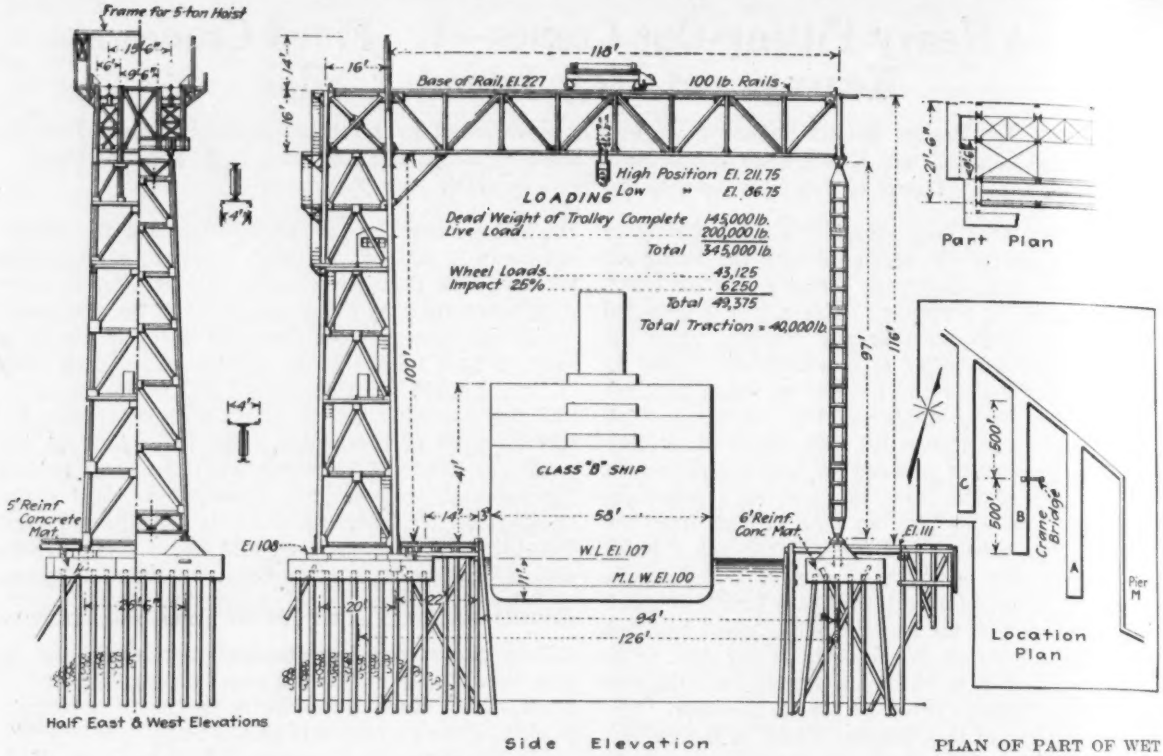
Fitting-Out Piers Carry Tracks and Motor Roadway

Each pier carries four standard-gage tracks, two on each side. In the middle is a plank roadway for motor-truck traffic. Much of the lighter equipment and supply handling from warehouse to ship is being done over this road. The outer track on each side of the pier is laid between the rails of a gantry track 16 ft. wide. Locomotive portal cranes run on the wide-gage tracks, cars passing under them. Numerous locomotive cranes, which also pass under the gantries, have been provided to do the light work. Two types of portal crane are used, light and heavy (Fig. 3). Each of six piers will be equipped with four of the lighter gantries, machines 33 ft. high with 55-ft. boom and capable of handling 5 tons at 50-ft. radius. One pier will have four heavy gantries, 43 ft. high to the turntable, with boom of 70-ft. maximum reach, and capable of handling four tons at 70-ft. radius. These machines, designed and built by the Myler-Interstate Co., Bedford, Ohio, are rated at 25 tons and 35 tons, respectively.

Pier B, which has the heavy gantry cranes, is to be used for all the heavy fitting-out work. At mid-length of this pier a crane bridge is erected, spanning between a support on the pier and an outboard pedestal built on a pile cluster in the water. This bridge supports a 100-ton trolley, capable of lifting from the bottom of the hold of a loaded ship, about 13 ft. below mean tide level, to about 104 ft. above high tide.

The choice of this crane bridge as the heavy-lift machine of the fitting-out work was determined, after a number of crane types were considered, by cost and quick availability, in combination. Early inquiries by the corporation showed that crane machinery of large capacity would be scarce and slow in delivery; but a 100-ton trolley was found available at the Alliance, Ohio, works of the Morgan Engineering Co. The further design of the crane was developed accordingly.

As built, the bridge represents the resultant of six or eight different designs, all involving the arrangement of a trolley track extending out from a support on the pier to an outboard support. The design adopted,



PLAN OF PART OF WET BASIN

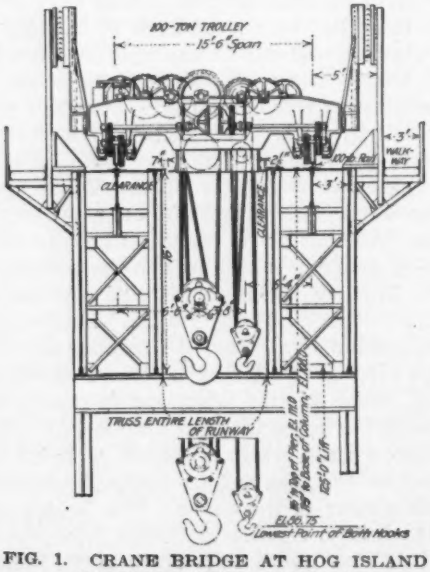


FIG. 1. CRANE BRIDGE AT HOG ISLAND CARRIES 100-TON TROLLEY

shown in Fig. 1, is that which at lowest cost gave the desired structural flexibility to permit automatic adjustment of the bridge to slight settlement.

Soft bottom throughout the fitting-out basin made pile foundations necessary. It was found that piles 55 to 60 ft. long brought up hard and could be counted on for 15 tons working load. For adequate stiffness of the concentrated cluster piles of the main tower foundation and the pedestal foundation, riprap deposit was used to brace these, in addition to a number of batter piles. The loading was held down to nine tons, in spite of a capacity of 15 to 20 tons per pile. These precautions were taken with special regard to the security of support of the crane bridge structure. The pier piles were also designed for a working load of nine tons but were not stiffened with riprap.

Spanning 116 ft. between column centers, the crane bridge commands a clear water width between the faces of pedestal fenders of about 80 ft., and gives a vertical clearance of 100 ft. above the pier tracks, or 111 ft. above mean tide level. The largest ship being built at Hog Island under present contracts is an 8800-ton vessel 58 ft. wide, but the crane is capable of serving a vessel 76 ft. wide, so that it would be possible to outfit or load large transport vessels.

Material will be brought to the crane on the outer pier track, which passes the main tower and thus is under the bridge. The supporting framing under this track is part of the pier structure, and with its pile support is independent of the tower foundation.

Completely rigid construction was not thought advisable, partly in view of temperature expansion of the bridge and partly in view of the possibility of differential settlement of tower and pedestal foundations. For this reason the outboard support was made a rocker bent The main support is a four-post tower to which the bridge is rigidly braced.

Both foundations have reinforced-concrete mats carried on the piling. Under the main tower the mat is 5 ft. thick and is arranged in the form of a hollow square; low footing piers rise above the level of the mat. The water leg has a similar mat 6 ft. thick, carrying footing piers 3½ ft. high spaced 25½ ft. apart.

The structural arrangement as well as the bracing are clearly shown by Fig. 5. Concerning the proportions of the plant, it may be noted that the maximum load on the two inner columns of the main tower is

540,000 lb., and that on the two rear columns 253,000. Each of the two rocker posts carries a maximum load of 406,500 lb., or a maximum uplift of 126,000.

The trolley in Fig. 1 has a wheel gage of 15½ ft. Both main and auxiliary drums are longitudinal. The machine is driven by alternating-current electric motors (although the gantries and locomotive cranes are steam-operated).

The stresses in the structure were computed on different assumptions for tower and bridge. The bridge was proportioned as if the truss were simply supported at both ends, and the loading on the outboard leg was determined on the basis of this same assumption. The tower, however, was designed on the assumption of rigid connection between truss and tower. A 30-lb. wind load was taken into account.

A hoisting speed of about 8 to 10 ft. per second is obtained with the main hoist of the trolley, under full load. The auxiliary hoist gives a lifting speed of about 30 ft. per second. In both hoists the two ends of the rope wind on the drum simultaneously, the middle of the rope being becketed over a small sheave to equalize.

H. M. Boyajohn, structural engineer of the plant department of the American International Shipbuilding Corporation, under whose supervision the design of this bridge was developed, gives its steel weight as about 300 tons and the cost of the crane, including foundations, bridge and trolley, as about $150,000.

Huge Derrick on Steel Platform Serves Federal Fitting-Out Basin

Simplicity in adapting the available resources in materials and machinery to the lift and reach requirements dictated the solution adopted by the Federal Shipbuilding Co. At this yard vessels are fitted out while lying alongside a timber wharf or dock. A lifting capacity of 100 tons was desired. To span the full deck width of the largest ship likely to be berthed at the wharf required a reach of 55 to 60 ft. outboard of the bulkhead line; to reach across the ship and lift from a barge beyond, 80 to 100 ft. A large reach was also desirable in order to cover a considerable length of the ship near the center line. The design problem was worked out on the basis of these requirements by O. E. Hovey, assistant chief engineer of the American Bridge Company. As in the case of the ship-erection derricks of the Federal yard, derrick equipment and hoisting engines proved the most quickly obtainable of all the lifting devices which were considered. Derrick rigging and machinery that had been tried out thoroughly in the erection of the Hell Gate arch bridge was available, suiting the required service with but little change. The possibility of controlling a long-reach boom with maximum load was known from that work, though the slewing was there done by side falls (a 180° swing sufficed) while for the large arc of slewing required at the fitting-out basin a bullwheel had to be resorted to. In view of the importance of getting the crane built and into service quickly, it was decided to take over the hoist, blocks and other equipment of the Hell Gate derrick, and with minor changes in these parts to build the rest of the crane to suit.

Under these conditions, the structure was designed as a boom derrick with pillar-crane mast, having a reach of 92 ft. 10 in. from mast center or 10 ft. less from face to dock wall, and a lifting capacity of 100 tons with boom horizontal, the whole mounted on a platform about 42 ft. above ground spanning the supply tracks. The platform has a triangular ground plan, with the forward point, where the mast is set, 10 ft. inshore of the bulkhead, and the sides of the triangle extending back at angles of 45° to the bulkhead line. The three legs of this platform are supported on large pile foundations (about 80 piles at the front leg and 50 at each of the rear legs) surmounted by concrete pedestals, which in the case of the rear foundations serve also as counterweights, being engaged by long anchor bolts.

In working out the details of the structure practice in building steel-erection equipment was followed closely, but for permanence of service lower stresses were used and bearings and oiling arrangements were developed more elaborately. The working stress in the steel was fixed at 16,000 lb. per square inch (reduced by the A.R.E.A. formula for compression); under maximum load conditions a 30-lb. wind was assumed, while a 50-lb. wind was figured for the unloaded structure. Both boom and mast were proportioned for combined compression and flexure, the extreme-fiber stress governing. Both are made of two ribs latticed; the mast is parallel-sided while the boom is tapered at both ends in the vertical plane and at the outer end in the horizontal plane. The pillar-crane arrangement of the mast was resorted to because of its

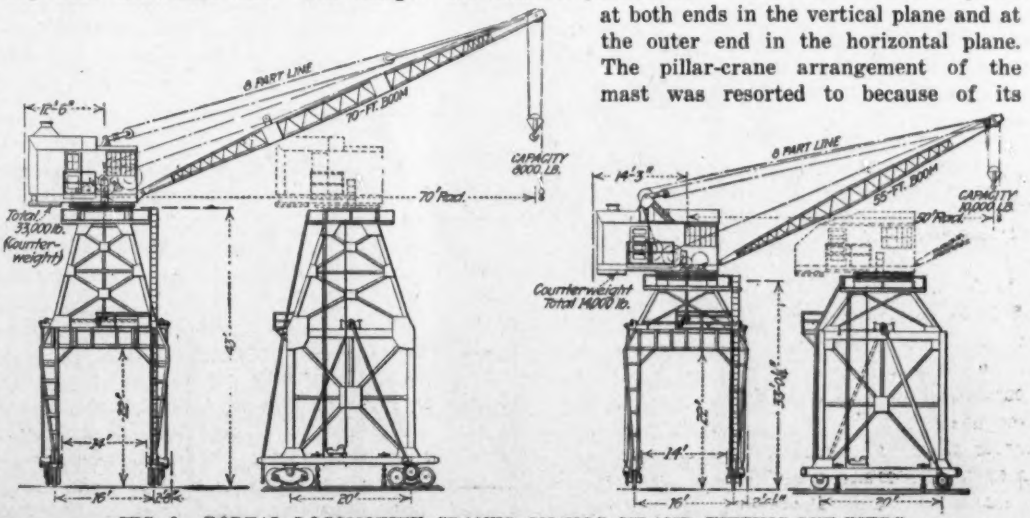


FIG. 3. PORTAL LOCOMOTIVE CRANES ON HOG ISLAND FITTING-OUT PIERS

advantage in making the upper bearing a pure ring bearing, and therefore simplifying oiling as well as allowing easy renewal of both bearings. It required a very special structural detail at the top to transfer stress centrally from the upper collar bearing of the mast to the stiffleg. A thick horizontal gusset plate surrounding the upper half of the upper bearing at mid-height engages two short

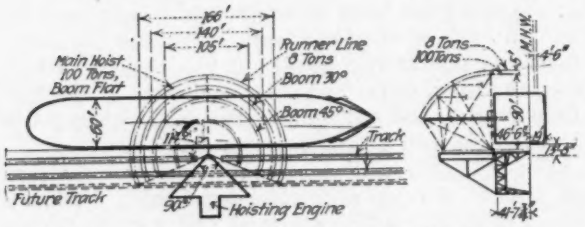


FIG. 4. REACH DIAGRAM OF ONE HUNDRED-TON FITTING-OUT DERRICK

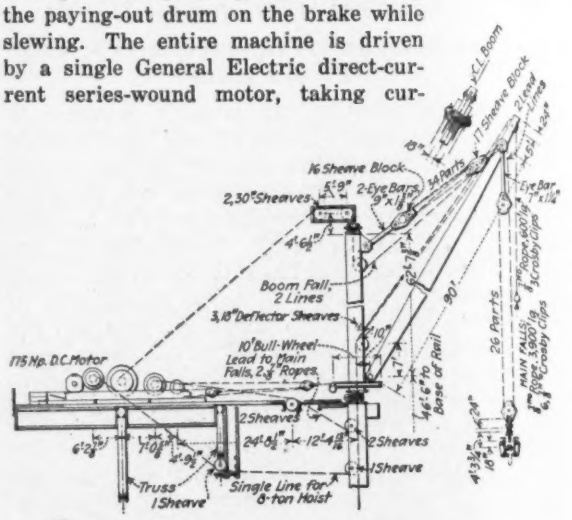
riveted horizontal struts of such width as to fit between the pairs of gusset plates at the upper points of the two stiffleg triangles.

The lower half of the step bearing at the foot of the mast contains a bronze step ring and a bronze cylindrical liner, taking weight and thrust. The horizontal thrust is taken from the bearing to the top chords of the platform trusses by two struts pin-connected to the bearing and the truss chords. The bottom of the bearing casting, turned to the shape of a spherical segment, is seated in a spherical socket in a pedestal casting attached to the main column of the derrick platform. Rotation of the bearing casting in the spherical pedestal socket is prevented by overlapping lugs on the two castings. The spherical bearing was provided because calculations of the mast bending showed that the angular deflection might amount to as much as 17′, sufficient to make a rigid bearing bind or seize. The spherical seat, machined on both faces, is oiled by three radial grooves connected by a ring groove.

The upper bearing of the mast is a simple collar bearing lined with bronze, the two castings, however, being so shaped as to form an oil reservoir surrounding a central hole through which passes the topping-lift rope.

In the Hell Gate bridge erection, derricks with a 26-part load hoist and a 40-part boom hoist were used, the boom hoist being arranged with two ropes, of which the four ends were taken on two drums each divided by a middle flange. The present derrick has the same load rigging, namely, 26 parts, but the boom hoist has 34 parts, made of a single rope whose two ends go to the same drum. A partition at mid-length of the drum keeps the two sets of windings apart. The load hoist also has its two ends led to the opposite ends of a single drum.

The hoisting engine, a four-drum Lambert machine, is the same as that of the Hell Gate derrick. Of the four drums, that in the rear takes the single line of the auxiliary hoist (eight tons). The second drum from the rear, which handles the topping lift, has been jacketed to larger diameter for increased hoisting speed and fitted with a central flange to separate the two windings. The third drum, also slightly modified by jacketing and by adding a central flange, takes the main hoisting rope. The front drum has been removed, and outside short drums attached, with independent clutches and brakes, for swinging the derrick. With this arrangement, in swinging the derrick it is always possible to keep the swinging rope tight by holding the paying-out drum on the brake while slewing. The entire machine is driven by a single General Electric direct-current series-wound motor, taking cur-



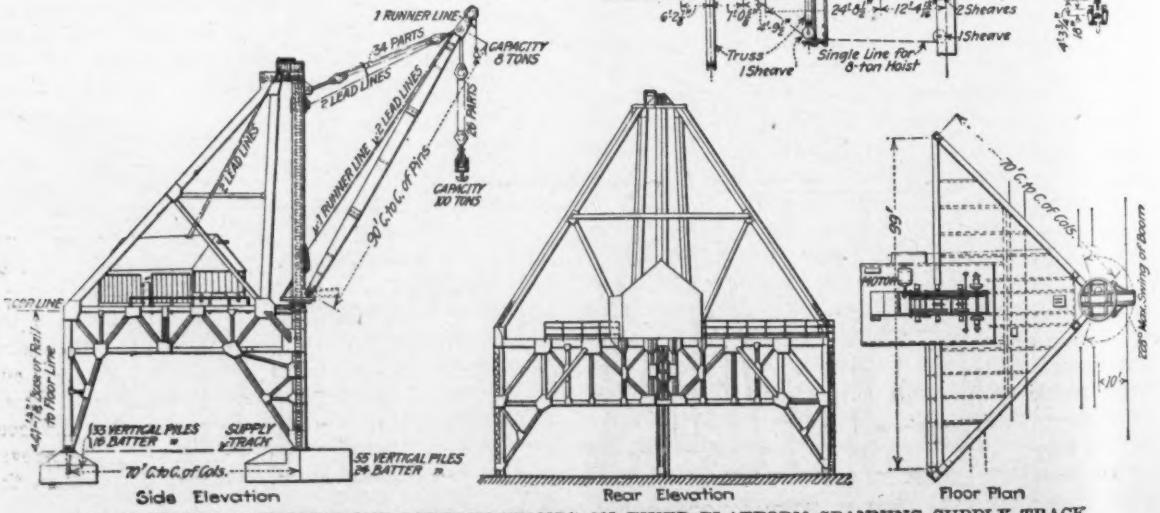


FIG. 5. FEDERAL FITTING-OUT DERRICK STANDS ON FIXED PLATFORM SPANNING SUPPLY TRACK

rent at 230 volts; it is rated at 230 hp. and 425 r.p.m. Automatic-acceleration control is provided.

The auxiliary hoist, at the end of the boom, 5 ft. beyond the center line of sheave of the main hoist, can be operated as a single line, but to give better control of the lowering a lower block, giving three parts, is used.

The entire machine is designed for ¾-in. rope, the same size of rope as was used in the Hell Gate erection work. The main hoist has a one-piece upper block, but a five-part lower block. The latter has five separate hangers, pin-connected to an equalizing girder. A rocker girder pin-connected to eyebars depending from this equalizing girder supports by pins a saddle strap in which is mounted a roller-bearing turntable from which the hook is hung. A four-prong hook is used. The main hoist-block sheaves and all other full-speed sheaves are 30 in. in diameter. The main blocks of the boom hoist are 20 in. and 16 in. in diameter in the groove. The operating speeds of the principal motion are approximately 12½ ft. per minute hoisting speed at maximum load, and 8 ft. per minute inhaul for the topping lift under most adverse conditions.

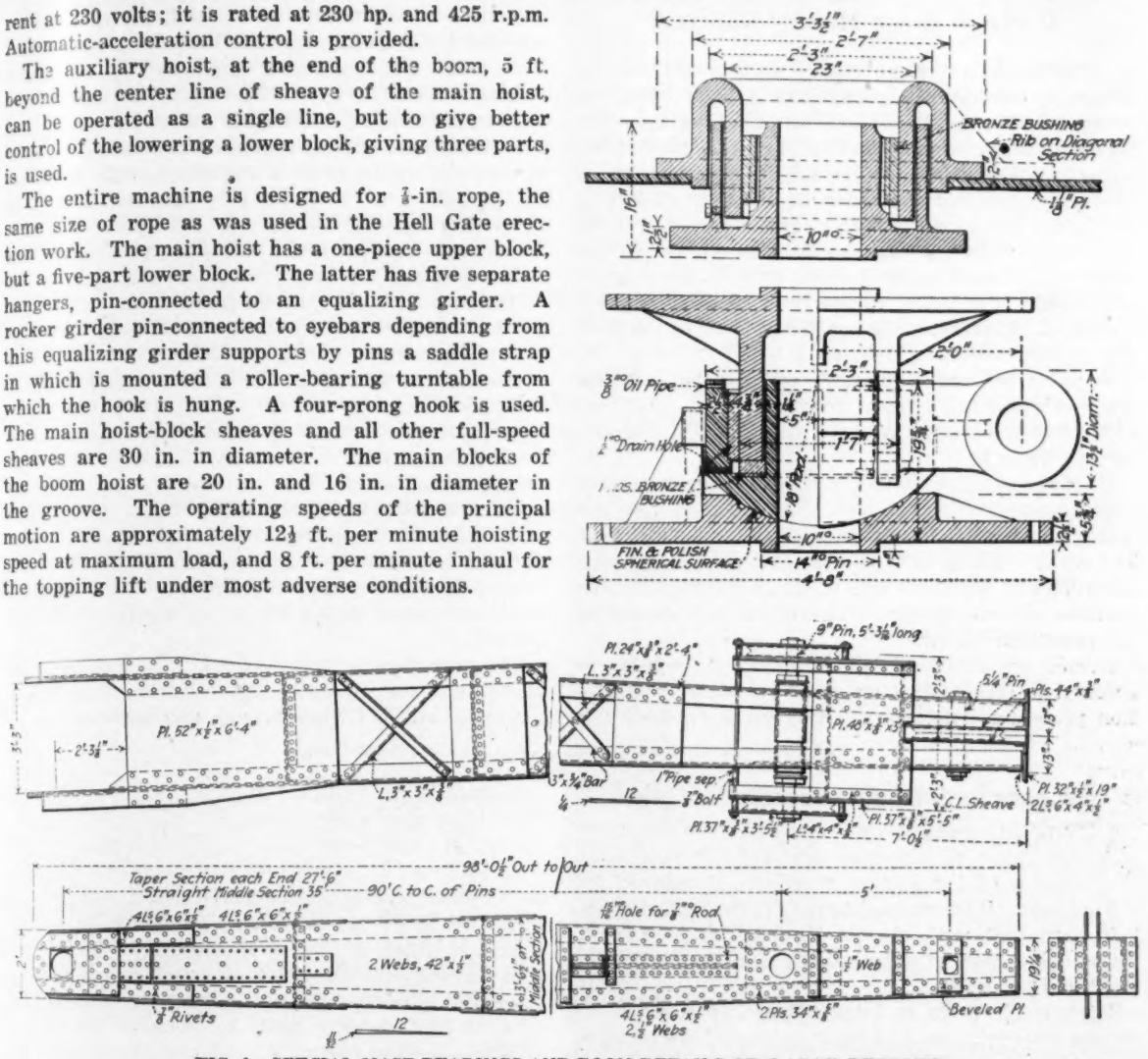


FIG. 6. SPECIAL MAST BEARINGS AND BOOM DETAILS OF LARGE DERRICK

As the designer wished to secure a high degree of rigidity in the supporting structure of the derrick, the platform was braced with unusual thoroughness, as may be gathered from one of the views of this derrick, though a large part of the bracing does not appear in the drawing.

A duplicate of the Federal crane has just been built for the Chickasaw Shipbuilding Co., Mobile, Ala.

Welfare Work for Employees in the Shipyards at Seattle

Living quarters at reasonable rates for women employees, apartments for employees' families, and a $1000 life insurance policy, gratis, for every employee, are some of the features of welfare work recently undertaken by the Skinner & Eddy Co. of Seattle. The apartment houses are being built near the yard at a cost of about $300,000, and will be rented for $25 or $30 per months for 3- and 4-room apartments. The six units involved are arranged in a hollow square, the interior of which will serve as a park and playground. Each of the six units is named after a vessel launched at the shipyard. Accommodations are provided for 180 families, and if this is not enough four more units can be added conveniently. To accommodate the women employees, the company obtained five-year leases on three structures in the high-class Capitol Hill residence district. In these buildings living accommodations are provided at cost. Meals are obtained elsewhere. Space for 300 persons is included in the three structures, some part of which space is still occupied by the previous tenants. The company now has only about 240 women employees, but this number is being rapidly increased, as it is planned to replace men with women wherever the latter are found to do the work as well as the former.

Costs of Hetch Hetchy Railroad

SIXTY-EIGHT miles of railroad connecting the Hetch Hetchy dam site with the Sierra Railway have been completed to the extent that material has for some time been delivered over the line. The construction was not unusual, considering the rough, mountainous region traversed, but opposition on the part of mining companies became an important factor in the progress and cost of the work. As the road is built for freight traffic only, sharp curvature was used to avoid heavy cuts wherever possible; curves from 18 to 26 deg. are numerous, the maximum being 30 deg. Most of the climb for ingoing freight will be on 3 to 4% grades. For nine miles between Hog ranch and the dam site the roadbed width is 22 ft. at subgrade. The remainder of the line has a 16-ft. roadbed with slopes on embankment of 1½ to 1.

Of the million cubic yards of excavation necessary, about one-quarter was in rock. In the surveys the material was classified as granite, solid rock, soft rock and earth. Alternate bids were invited for this classification and for a flat rate of 68c. per cubic yard, regardless of classification. The latter was chosen by the successful bidder.

Several owners of mining claims along the line who objected to the construction made resort to condemnation proceedings necessary. A price of $100,000 was demanded by the owners of one claim, despite demonstration by the city geologist that the claim was of little value. After long court procedure, the city finally obtained the claim by condemnation, the court allowing the owners $160 as the fair value.

In other cases, where opposition was on the ground of depreciating the value of mining prospects by dumping excavated material, the city was unable to settle the matter so satisfactorily. In the Tuolumne Cañon, for example, the line passes just above a series of placer claims on which excavated material was certain to fall. In the confines of the narrow cañon no alternative disposal of material was apparent, until the city hit on the plan of building up dry rubble masonry retaining walls above the mining claims. This plan worked well. In this cañon on one claim alone there was built up 1500 ft. of wall averaging 15 ft. high. Rubble masonry retaining walls on other sections of the line range in height up to 30 feet.

Including the steel bridge of 220-ft. span with three 40-ft. plate-girder approaches, and about half a million feet of lumber in trestles across small streams, the total cost of the completed line, including ballasted track, was about $2,000 000, or an average of $29,400 per mile.

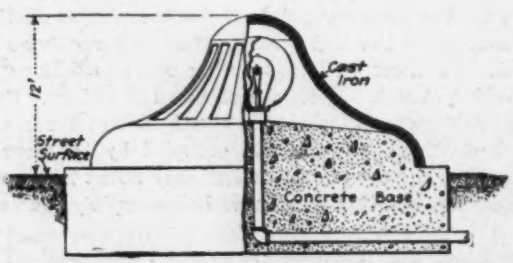
The railroad was built by the City of San Francisco as a part of its new water-supply system, under the direction of M. M. O'Shaughnessy, city engineer.

Propose Less Dangerous Traffic Guide

A TRAFFIC guide which is said to be less dangerous than those in ordinary use is recommended by the Director of the Bureau of Mines, Department of the Interior. It is designed to replace the common 6- to 8-ft. iron post with electric light which is used to mark the center of intersections and to divide the right and left traffic.

High traffic posts at intersections are a source of danger from collision, and many accidents have occurred from this cause. The light at the top is too high for the ordinary line of vision of the driver who is watching the surface of the street, and when a collision occurs the rigidity of the post causes great damage to the vehicle.

Many advantages are claimed for the device shown in the illustration. Chief among them is the fact that, extending only 12 in. above the surface of the pavement, it is large enough to be visible in the daytime and when lighted in the night, without endangering the lives of passengers in a vehicle which by accident passes over it. At the same time its 12-in. height is enough to hit the axles of ordinary motor vehicles and keeps them from running the risk. The cast-iron top is so arranged that under violent collision it will be forced from its base. A suitable color makes it readily visible in the daytime, while the electric light inclosed in the slotted cast-iron top affords visibility at night.



TRAFFIC GUIDE HAS CONCRETE BASE WITH LIGHT GUARD OF SLOTTED CAST-IRON

Several different shapes of top were experimented with to determine the effect of wheel impact, and the general shape shown in the illustration was found to give the best results. Otto H. Mohr, of the Bureau of Mines, is the originator, and upon application will give further information and blueprints.

Jerusalem Has New Water-Supply

Following closely upon the occupation of Jerusalem by the British, investigations for a new water-supply were begun by the Royal Engineers. Four days later a scheme was outlined. This was on Feb. 14, but shortage of transportation facilities and bad weather put off the beginning of construction until about the second week in April. On June 18 water was being delivered. The supply is pumped from springs to the city. According to a short note in the London *Surveyor*, of Aug. 16, many miles of pipe have been laid, and the supply is being delivered directly to hospitals, to "standpipes in every quarter of the city" and also to cisterns, the latter on condition that the cisterns be cleaned out to the satisfaction of the water authorities before they are filled. The daily yield of the springs is about 400,000 U. S. gal. The water consumption of the city is said to be about ten times what it was formerly. The *Surveyor* reports that the "beneficial effects upon the health of the city has been instant and widespread."

New Factory Designed to Increase Production Efficiency

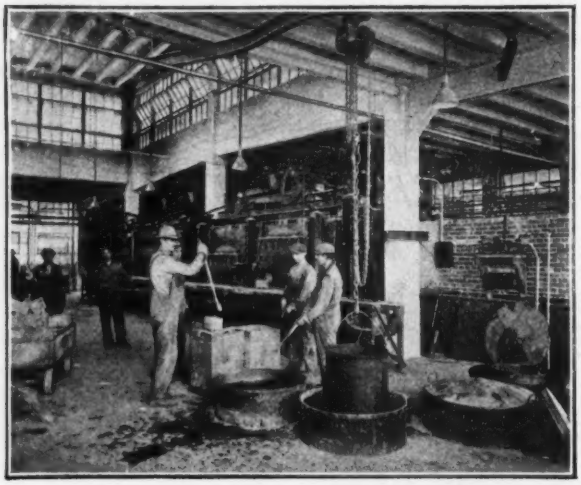
Permits Effective Utilization of Working Space And Contributes to Better Working Conditions of Employees

CONSIDERATION of the best possible working conditions for employees, and a layout of buildings and equipment which would facilitate production operations, were the primary objects in view in the design of the new factory of the Diamond Chain & Manufacturing Co., in Indianapolis, Ind. The plant, which comprises two adjacent buildings, was built on a new site, and when completed was taken over as a whole, the old factory being abandoned. It consists of a four-story building 60 ft. wide and 460 ft. long, and a one-story building 80 ft. wide and 300 ft. long, the two being separated by a courtyard 20 ft. wide and connected by two passageways at the street level. Both structures are of reinforced concrete. Preliminary to the making of the design, it was decided that the following ideas and policies would have to govern in laying out the new plant: Production must have logical sequence. The buildings must be so built as to be easily extended or added to. They must be of standard design or construction, so that they could be converted into other types of manufacturing than that for which the company intended to use them. The construction must be economical both as to the structure itself and to the use of ground. The whole plant must have a good appearance. Careful attention must be given to daylight lighting and to the elimination of disagreeable conditions of heat, odors, etc., which might be expected from the type of manufacturing to be carried on.

As a result of these, the main manufacturing building was designed as a four-story building with flat-slab floors, 60 x 460 ft. in clear area, and with all service necessities in projecting wings or towers, so that the manufacturing operations on each floor could have the advantage of the clear space of the main-floor area. Two of the accompanying views show how this space is utilized effectively. Flat-slab construction was adopted not only because of the structural advantages, but because of the greater cleanliness of ceilings and less obstruction to light. It was considered that the psychological effect of a clear ceiling on the work people would be advantageous. The width of 60 ft. was selected because it was the maximum width in which practically even lighting could be secured clear across all the floors from the side windows—which, incidentally, occupy practically all of the inter-column space of the wall. The tower and wing additions contain the toilets, drinking fountains, stairways, wash rooms, and, on one floor, the kitchen. Transportation inside the building was made a special point in the planning. All the heavy moving is taken care of by the truck system shown in one of the views, in which a small electric motor truck of

UPPER—IN DIAMOND CHAIN AND MANUFACTURING COMPANY'S NEW PLANT—NARROW BUILDING WITH PROFUSION OF WINDOWS PERMITS WORKING UNDER BEST POSSIBLE CONDITIONS. LOWER—OVERHEAD BEAMS CARRY MOVING CHAIN HOIST FOR MATERIAL DISTRIBUTION TO SPECIAL METAL TABLES LINING AISLES

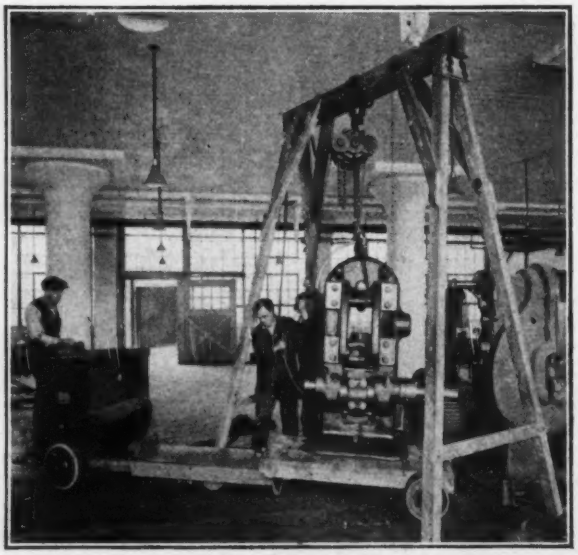
the baggage-moving variety is slid under a platform truck provided with two forward wheels and two rear standards. To carry these motors, practically all the floors are of No. 1 factory maple, laid upon creosoted sleepers embedded in concrete placed upon the concrete floor-slabs. In some parts of the building I-beams are



FURNACE ROOM IN CHAIN MANUFACTURING PLANT IS CLEAN AND WELL LIGHTED

hung by special clips to wood stringers fastened to inserts in the ceiling, and are used as tracks carrying a traveling chain hoist. One view shows such I-beams carrying a dumping can along an aisle lined with tables which take the parts emptied from the can. Another view shows a similar installation of the overhead I-beam carrier in the furnace room of the one-story building described later.

All the ceilings in the building had inserts placed at approximately 3-ft centers. Every bay has a uniform spacing of these, so that shafting can be shifted from one bay to any other and meet the same conditions. Longitudinal wood beams are bolted to the inserts, and cross-beams carrying shaft hangers are then bolted to the longitudinal beams. This plan gives practically the same ready control of shaft positions as is offered in a wooden building.



FREIGHT AND EQUIPMENT ARE MOVED BY SMALL TRUCK WHICH RUNS UNDER A MOVABLE PLATFORM, THE TWO FORMING A MOTOR TRUCK

The one-story building is used for the furnace and the heat-treating operations. On this account it was made only one story, so as to reduce the ventilating difficulties. The building consists of three transverse bays with two rows of interior columns and longitudinal stringers with transverse cross-beams, carrying a monitor roof along its entire length. The lighting here is remarkably effective, as the view of the furnace room herewith will show. The contrast between this orderly, well lighted shop and the old-time dirty and dark furnace room is remarkable. In this section, where extra-heavy trucking is required and where the heat of the forgings comes very near the floor, a brick floor was used instead of the wood floor used in the main building.

In order to assist the illumination due to the wide and frequent windows, and to help also the artificial illumination that is effected by the use of frequent ceiling incandescent bulbs, the inside of both buildings is painted white.

The views show, too, the cleanliness and order of the working floors in the main building as well as in the one-story shop. Special metal working tables are provided for most of the sorting operations. The welfare of the work people, in addition to the provisions for better working conditions, is taken care of by a hospital and a restaurant in the building.

Feed Canal Over Divide Saves Irrigators

But for the timely construction of the feed canal from an adjoining watershed the Orland Irrigation Project of the United States Reclamation Service in California would have been affected disastrously this year. As noted in *Engineering News-Record* of June 20, p. 1186, the feed canal has 200 sec.-ft. capacity and was constructed for just such emergencies. As it is, the supply was short, and irrigators have had to be restricted to 1½ acre-ft. per acre. East Park reservoir holds 51,000 acre-ft.; the hold-over from last season was 2500 acre-ft., and the run-off from the watershed above the reservoir was 16,000 acre-ft. Without the 24,400-acre-ft. diversion by the feed canal the storage would have been depleted by July 15. On some indifferently leveled land, on gravelly soils and on areas where water was applied carelessly, only two crops of alfalfa have been cut.

In general, throughout the project three crops were realized, and on many ranches four. All orchards have had more than sufficient water as well as other crops on reasonably well-prepared ground, properly irrigated and cultivated.

The water users of the project took the prorating to 1½ acre-ft. per acre in good spirit. At a recent meeting a proposed appeal on this account to the Government for a suspension of this year's construction costs was voted down by a large majority.

New York Central Relocates Lines to Cross Barge Canal at the Tonawandas

Detour Two Miles Long Around Hearts of Cities at Once Combines Two Bridges Over Waterway and Solves Difficult Problem of Eliminating Grade Crossings and Occupation of Main Business Streets

BY B. S. VOORHEES
Engineer of Grade Crossings, New York Central Railroad

A NEW line about 10,300 ft. long is being constructed by the New York Central R.R., as a new location for its combined Niagara and Tonawanda branches, at the cities of Tonawanda and North Tonawanda, N. Y., in order to cross the westerly terminus of the New York State Barge Canal by one bridge instead of two and accomplish at the same time the elimination of 13 dangerous grade crossings and the lengthwise occupation of the cities' principal business streets. The improvement involves the building of a double-track elevated roadbed on earth embankment, the construction of a bascule lift bridge over the Barge Canal and 11 bridges over streets, and the relocation of the Tonawanda and North Tonawanda stations and facilities.

The New York State Barge Canal finds its western terminus about 10 miles north of Buffalo, at the point where Tonawanda Creek flows into the Niagara River. On the northern and southern banks of Tonawanda Creek at this junction are situated the twin cities of Tonawanda and North Tonawanda. The old Erie Canal is located along the southern bank of Tonawanda Creek, as it approaches this locality from the east, until it reaches a point near Main St., Tonawanda, where it leaves the river and passes in a southwestern direction within its own banks. The Tonawandas constitute the third largest industrial center in the State of New York.

RAILROADS AT THE TONAWANDAS

These railroads serve the Tonawandas:

The Niagara branch of the New York Central, which connects Buffalo and Niagara Falls, enters the city of Tonawanda from the south on two main tracks, and runs lengthwise in Main St. to Young St., intersecting seven cross streets at grade in Tonawanda; thence by a single track and on a fixed bridge it passes over the Erie Canal and Tonawanda Creek and enters Webster St., intersects four cross streets in North Tonawanda at grade, and extends to a Y junction at the termini of the New York Central's single-track line from Lockport and its line from Batavia known as the Tonawanda branch. This branch enters the city of Tonawanda from the east on its own right-of-way, and consists of two main tracks to a point about 700 ft. southeast of Tonawanda Creek, where it crosses at grade two parallel tracks, one of the International Ry., the other of the Erie R.R., and thence continues northerly on a single track on a fixed steel bridge over Tonawanda Creek and two adjoining streets. In the 1600 ft. from this crossing to the Y junction are two street grade crossings.

The Erie R.R. and the International Ry. run from south to north through the Tonawandas, and cross Tonawanda Creek on a common fixed bridge about 400 ft. east of the New York Central's Tonawanda-branch crossing.

In addition to the regular New York Central traffic, Michigan Central trains run over the Niagara branch and Lehigh Valley trains run over the Tonawanda branch. At the railroad junction point in North Tonawanda, and for about 2000 ft. north, are situated railroad yards which provide interchange facilities between the various railroads and lead to the various industries, chief of which are large lumber mills west of the railroads along the Niagara River front and on Tonawanda Island.

Immediately west of the Niagara-branch crossing of Tonawanda Creek is the vehicular and pedestrian bridge connecting Main St., Tonawanda, and Webster St., North Tonawanda, which are the principal business streets of these cities.

REASONS FOR CHANGE OF ALIGNMENT

These Niagara frontier cities have aspired to a large industrial and commercial development in conjunction with the Barge Canal improvement, and by their combined efforts succeeded in obtaining from the Federal Government a 23-ft. depth of channel from Lake Erie to the Tonawandas to accommodate the largest vessels of the Great Lakes. They also obtained recognition by the Barge Canal Terminal Commission of the adaptability of Tonawanda Creek as a harbor for the docking of lake vessels, and consequently the continuation of the deep channel into the canalized creek—a project which necessitated lift bridges to replace the existing fixed bridges, as well as the planning of proper docking and terminal areas along the shores of the creek.

To meet the requirements of Barge Canal navigation only, it would have been necessary to rebuild both the Niagara-branch and Tonawanda-branch railroad bridges, as well as the Main-Webster St. bridge, which bridges interfered with the canalization of the creek by reason of their restricted vertical and horizontal clearances. To have raised the Main-Webster St. bridge and the Niagara-branch railroad bridge to meet these requirements would have been not only very expensive, but ruinous to traffic and the adjoining property and streets, particularly as there already existed a hump in the track over the creek at this point with approach grades of about 1 and 1.5 per cent.

THE FIRST SOLUTION

Naturally, the first solution of the problem that presented itself was the reconstruction of the Barge Canal bridges into movable bridges at their present locations. There was a very serious objection to a movable bridge on the Niagara-branch railroad crossing of the creek, where there was a stretch of single track in a double-

track railroad, heavily traveled, and which under such conditions would create a situation that would have been suicidal to successful railroad operation. It was proposed to overcome this objection by filling in the gap of single track by the laying of a second track through Webster St. and the construction of a bascule double-track lift bridge. Negotiations were carried on between the state Barge Canal authorities and the railroad on this basis, and a mutual arrangement resulted by which the expense was to be shared by both parties.

Many objections developed, however, to the occupation by the railroad of this important street, from the points of view of the city of North Tonawanda and the business establishments, as well as from the point of view of railroad operation. With about one hundred regular train movements per day and many switching movements, making a train movement about every 11 min. along the streets and over the crossings on the Niagara branch, the conditions were exceedingly dangerous to street traffic and particularly annoying to operation, since they necessitated the imposition of speed restrictions on train movements.

The idea was then evolved of relocating the Niagara and Tonawanda branches so as to carry them over the canalized creek on one bridge on a location removed from Main and Webster Sts., and thereby not only overcome the objections above mentioned, but also eliminate the grade crossings and lengthwise occupation of streets through the city and make unnecessary the construction of one bridge through which lake boats would have to pass to reach the Barge Canal harbor. On the basis of the negotiations that had already been carried on with respect to the Niagara-branch bridge at Main and Webster Sts., substitution of a single bridge for the two bridges not only meant the creation of better conditions for shipping interests, but a consequent saving to both the state and the railroad and the releasing of many dollars which could be applied to the realignment project.

Choosing the New Location

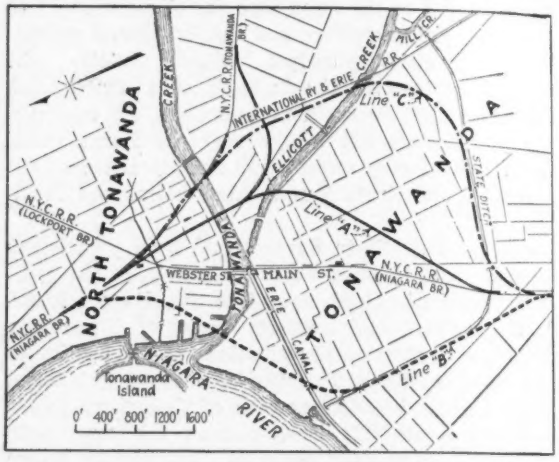
Three basic plans for the new location were proposed; they are designated on the sketch as lines A, B and C.

Line A relocates both branches and combines them in one bridge crossing at a point about midway between the two existing crossings. This location would accomplish the desired purposes and was the most satisfactory from the standpoint of railroad operation, but traverses the heart of the residential section of Tonawanda so that enormous property damage would result, and intersects the Barge Canal terminal areas which had been established by law and could not be obstructed. Before these terminal areas had been established, making highly undesirable if not intolerable a crossing at the location of line A, several variations of this direct and ideal alignment were studied, but all had to be abandoned because of the prohibitive right-of-way costs.

Line B was proposed by the city authorities and contemplated the relocation of the Niagara branch west of its present location. The line was to follow along a state ditch west of Main St. in Tonawanda, crossing Tonawanda Creek near its junction with the Niagara River and leaving the location of the Tonawanda branch unchanged. This state ditch leaves Mill Creek near its outlet into Ellicott Creek, in the southeastern part of Tonawanda, flows westerly until a few hundred feet west of Main St. and then turns northwesterly to the Erie Canal. Its location also has an important bearing on the projection of line C.

Line B could not be given serious consideration, because it did not eliminate one crossing of the Barge Canal and because it involved the serious objection of introducing an obstruction to navigation at the very point of its entrance into the Niagara River, so that all boats entering and leaving the harbor would have had to pass through this bridge.

Line C is the location that has been adopted for the new alignment. It relocates the Niagara branch in a sort of belt line, skirting the edge of the residential



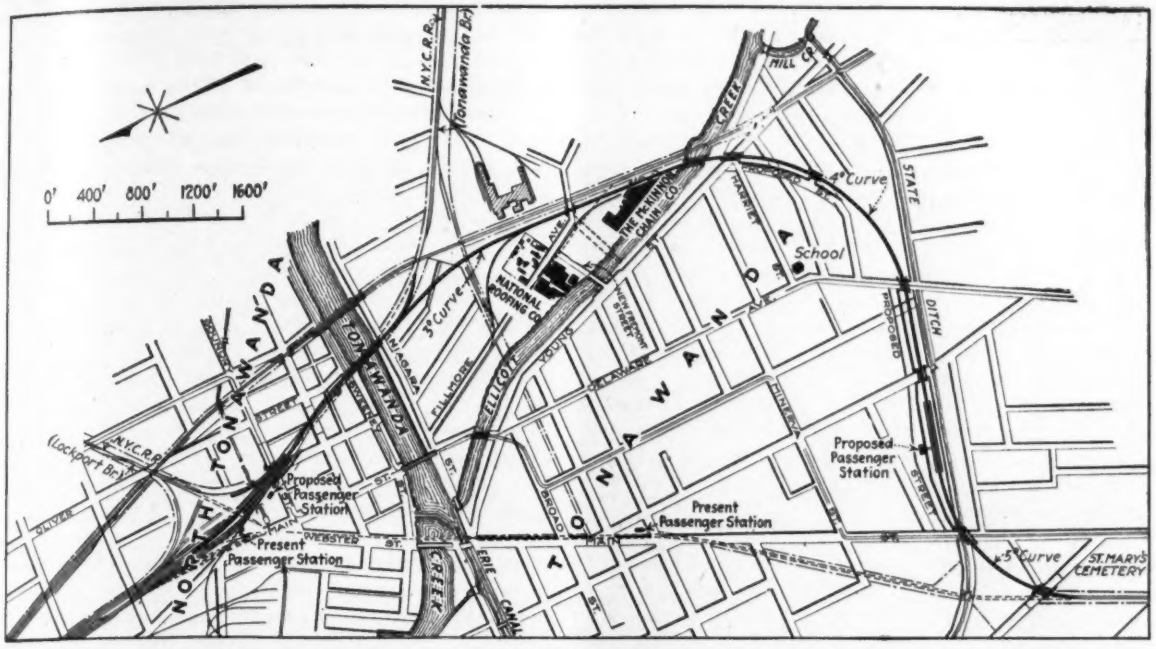
THREE ROUTES WERE STUDIED—LINE C WAS ADOPTED

section of Tonawanda along the state ditch east of Main St., and crossing Tonawanda Creek on a common structure with the Tonawanda branch near the point of the existing crossing of that branch, the alignment of which it follows approximately to the North Tonawanda junction.

This location introduces a rather poor railroad alignment, but accomplishes the desired purposes, and does so by confining the points of departure from the original alignment within the nearest possible limits and at the same time overcoming the objections to the other suggested locations.

Details of Location Adopted

The point of crossing the canalized Tonawanda Creek was chosen so as just to clear the eastern limits of the Barge Canal terminals. In order to avoid excessive curvature on the Tonawanda side of the crossing, and serious street and property damage on the North Tonawanda side, it was desirable to adhere as nearly as possible to the existing Tonawanda-branch alignment, which made an angle with the Barge Canal of about 68°. It was likewise very desirable to adopt a right-angle superstructure, as that was the basis of the negotiations with the state authorities at the Niagara-branch location, and would afford a lift bridge of simpler construction and operation. It was found that to keep the substructure at the water surface parallel to the canal, the bridge seats could not be skewed far enough



TWO MILE DETOUR SIMULTANEOUSLY SOLVES GRADE-CROSSING AND BARGE-CANAL-CROSSING PROBLEMS

to meet the direction of the existing Tonawanda-branch alignment, but that the maximum departure from normal was about 15°, which fixed the direction chosen for the alignment over the creek.

From the creek crossing south the new alignment was projected parallel to and adjoining the Erie right-of-way as far as Ellicott Creek, in order to avoid cutting into the large industries of the National Roofing Co. and the McKinnon Chain Co. From Ellicott Creek southwest the new alignment was located on a 4° curve to keep as far as possible from the built-up section, make a desirable intersection at the junction of Young and Harriet Sts., stay far enough away from the schoolhouse at Delaware Ave. and Harriet St. and meet a tangent projected along the north edge of the state ditch, a desirable location because it was removed from the developed land and because as a barrier it would be less objectionable where a natural barrier—the state ditch—already existed. It was necessary to introduce a 5° curve to swing into the old alignment at the south point of departure because of the limitations imposed by the location of St. Mary's Cemetery along the east side of the railroad at its entrance into Tonawanda.

Throughout the improvement the ground and street surfaces are generally flat and so low that the depression of streets was impracticable from a drainage standpoint; therefore the new grade had to be established at an elevation sufficient to pass over the existing street surfaces with a minimum underclearance of 13 ft. for ordinary street traffic and 14 ft. for street-railway traffic. This elevation is high enough to meet the Barge Canal vertical-clearance requirements at the crossings of Tonawanda Creek and Ellicott Creek, a branch of the Barge Canal improvement.

There are eight structures carrying the new double-track alignment over the streets in Tonawanda and three in North Tonawanda, and one fixed through truss bridge of about 200 ft. span over Ellicott Creek, besides the bridge over Tonawanda Creek, which consists of one 100-ft. bascule-lift span over the channel, another fixed span of about a similar length north of the lift and supporting the counterweight, and shorter spans to carry the tracks over South Niagara St. on the south and Sweeney St. on the north.

At four street crossings in Tonawanda where the necessary elevations could be obtained, the railroad is to be carried over the streets on reinforced-concrete arches with a view to reducing the amount of steel to a minimum on account of its nonavailability at this time of national need. The concrete masonry structures will have to be supported on wooden-pile foundations, as the subsoil is a wet, yielding clay.

For the crossing over Ellicott Creek it was found feasible to utilize a 200-ft. steel truss span which was to be removed at a point where the West Shore R.R. crosses an abandoned part of the old Erie Canal, and where the old canal could be filled in and the tracks carried on embankment.

Lift Span at Tonawanda Creek

The lift span at Tonawanda Creek is a double-track single-leaf Strauss heeled trunnion structure, that particular type being chosen on account of its simplicity, easy maintenance and operation, and the vertical lift was chosen on account of the objectionable interference of an ordinary swing bridge with vessels lying at the dock. The fixed span which supports the counterweight is a simple A-truss. This departure from the ordinary method of supporting the trunnion on a separate pier was made in order to afford another clear channel adjoining the northern dock wall of the harbor.

In addition to the structures and the railroad roadbed, which will require about 500,000 cu.yd. of embank-

ment, there are involved the relocation of the two passenger stations, one at Tonawanda and one at North Tonawanda, the rearrangement of the North Tonawanda freight-yard facilities, the construction of about 3500 ft. of new street to eliminate and simplify street structures, and of about 3000 ft. of low retaining wall, besides the restoration of the street surfaces in Main and Webster Sts., where the old location will be abandoned.

The Tonawanda station will be located at the southern end of the improvement, as near Main St., where electric cars run, as the curvature will permit. A new street will be constructed from Delaware Ave. to Main St. to facilitate access to the station. The North Tonawanda station will be located near its present site, on the north side of Goundry St., on which there is an electric line. Both stations will be of modern construction, with pedestrian subways and stairways leading to platforms on either side of the tracks to obviate the dangerous crossing of tracks by passengers.

An effort was made in developing the plans for the improvement to separate the grades of the Tonawanda-branch crossing of the International Ry. and the Erie, but the proximity of the new canal crossing to the canal crossing of the International and the Erie, and the fact that both of these river crossings are only about 500 ft. away from the railroad crossing, involved such difficulties in gradients as to make the expense of separation unwarranted, when the train movements over the Tonawanda branch are considered.

Erie's Industrial Connection

Another difficulty which arose was the fact that the new alignment, paralleling the Erie right-of-way and adjoining it on the west at about 10 ft. higher elevation, would cut off the Erie's industrial connection into Fillmore Ave., which served the two large industries of the National Roofing Co. and the McKinnon Chain Co. It was finally conceded by all concerned that a direct connection either at the grade of the new alignment or under it was impracticable, and the difficulty was overcome by an agreement in which the New York Central contracted under a special arrangement to switch cars for the Erie to the industries in the territory from which they were cut off.

At this point complications were also involved on account of cutting through the eastern part of the McKinnon Chain Co.'s plant. This houses an important industry engaged in Government contract work. A satisfactory solution of the problem resulted in the rearrangement of the plant, the relocation about 250 ft. north of Fremont St. and the bridge carrying it over Ellicott Creek in order to permit extension of the plant in that direction, and the reconstruction of the buildings and machinery for a reverse movement in the process of manufacture. All this added an expensive but unavoidable damage item to the cost of the improvement.

An interesting feature is the treatment of the state ditch at its head and at the point where it is crossed by the new elevated railroad roadbed at Main St., Tonawanda. The Barge Canal improvement lowers the waters of Tonawanda Creek and Ellicott Creek about 3 ft., so that by the removal of an earth dam in Mill Creek just below the state ditch, and the construction of another earth dam at the head of the state ditch, the waters of Mill Creek have been diverted from the state ditch to Ellicott Creek. This operation reduced the flow of the waters of the state ditch to such an extent that it was necessary only to construct a 4-ft. arch culvert to carry the surface drainage under the new railroad embankment and Main St., where otherwise a structure about 20 ft. wide by 400 ft. long would have been needed. A considerable saving in the cost resulted. The change in dams at the head of the state ditch necessitated the construction of a bridge to carry Mill Creek Road over Mill Creek, in place of the embankment which had formed the dam.

Negotiations consumed so much time that the difficulty arose of performing the construction work on the new alignment in time to meet the opening of Barge Canal navigation, which was set for May 15, 1918, and which would require a 12-ft. depth of water, with a minimum channel 50 ft. wide at the new location of the crossing, as well as at the old location near Main and Webster Sts. It was found impossible, on account of the unusual conditions of material and labor caused by the war, to complete the new alignment to carry traffic so that the old crossing could be abandoned in time to meet the opening of the Barge Canal navigation. This difficulty was overcome, however, by carrying the Tonawanda-branch track on a wooden trestle detour about 50 ft. west of its original crossing, and sliding one of the old half-through girder spans on skidways to the position of the detour, in which position it was supported on temporary cribbing surrounded by steel sheet piling in such a way as to afford the proper canal channel. The Niagara-branch track was retained in its old location and Barge Canal requirements were met at the bridge by substituting a second-hand through girder span for one of the deck spans and reinforcing and protecting the piers with concrete and timber falsework.

Status of the Work

The negotiations leading to the beginning of construction were very difficult and tedious because it was necessary first to agree with the state Barge Canal authorities and execute a contract with them, then secure the consent and franchises of both cities, and finally take the matter under the railroad law before the state Public Service Commission, which, after holding the various public hearings that were necessary, issued an order June 6, 1917.

The general contract covering the entire improvement was let to the New York State Dredging Corporation Mar. 17, 1917. The construction work was begun in July, 1917, and in spite of the material and labor difficulties the project is well under way. About 90% of the necessary new right-of-way has been acquired, several of the concrete arches and the substructure for the bridge at Tonawanda Creek are almost complete, and the embankment is being placed between Main St. and Delaware Avenue.

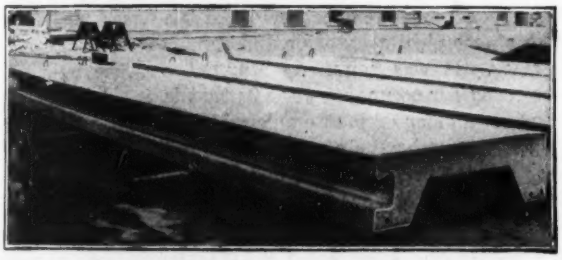
The work is being carried on under the direction of George W. Kittredge, chief engineer, and J. W. Pfau, engineer of construction.

Drive Inclined Precast Concrete Slabs for Sea Wall

Novel Type of Beach Protection at Long Beach, California, Replaces Old Vertical Concrete Wall

REINFORCED-CONCRETE precast slabs driven to form an inclined sea wall have recently been used by the City of Long Beach, Cal., to replace a vertical protection wall built about 1915. It is believed that material improvement over the design of the old wall, described in *Engineering News* of Apr. 15, 1915, p. 720, was made in working out plans for the new structure. With the vertical wall, excessive vibration was transmitted to the nearby structures when the impact of the waves was heavy, and the maintenance of the sidewalk behind the wall was excessive because the sand backfill washed out through open joints between slabs of the sea wall. In designing the new wall it was the purpose to provide adequate protection from the waves without vibration and to make a sightly, economical structure that would leave the beach unobstructed.

The structure consists of a continuous row of interlocked concrete slabs driven at an angle of 53° with the horizontal. The old sea wall was still in place for a considerable part of the length, and the inclined slabs were therefore located so as to bring their tops approximately 18 in. outside the old sea wall. The inclined and the vertical walls were then bonded together by a parapet wall extending 7 ft. above the top of the inclined slabs and having a minimum thickness of 12 in., reinforced with ⅜- and ⅝-in. bars. The sidewalk behind the parapet, 30 ft. in width, rests on a sand fill. Before placing of the fill a triple line of columns and beams parallel to the parapet wall was placed so that the sidewalk would not be dependent entirely upon the sand fill for support. These beams and columns were not considered necessary by the engineers, but were put in at the request of the property owners. Ornamental lighting standards were cast in place, using an aggregate which would pass an eight-mesh sieve. All of the other concrete on the job was mixed in proportions of 1:2:4.

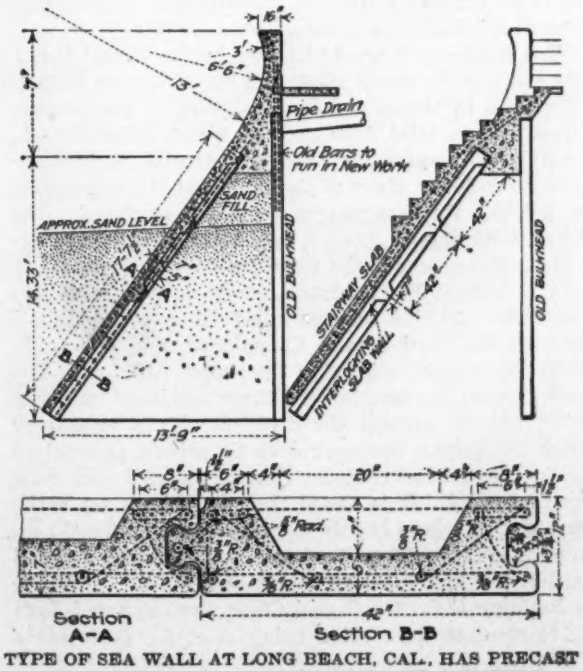


PRECAST CONCRETE SLABS USED IN SEA WALL

The interlocking slabs are each 42 in. wide, 17 ft. 7½ in. long and 5 in. thick in the panels. Horizontal beams bringing the total thickness up to 12 in. were placed at the top and at 42 in. and 82 in., respectively, below the top. For the most part the slabs were driven through a vertical depth of about 10 ft., of which the last 18 in. is a clay stratum for about 75% of the length of the wall. The slabs were placed by a special driving rig using steam hammer and water jet and provided with leads inclined at an angle of 53° to the horizontal. A detached hoisting engine was used in bringing up the slabs, and they were then handled and placed by means of a standard hoisting engine mounted on the rig. The jetting was carried on by the use of four 3-in. jets, nozzled to 1-in., the supply being from city mains carrying a pressure of 60 lb. per square inch.

IMPROVISED RIG IS USED TO DRIVE HEAVY SLABS

Backfilling was done in part with a ¾-yd. clamshell, the boom of which was mounted on one corner of the driving rig and operated by a separate turning and



TYPE OF SEA WALL AT LONG BEACH, CAL., HAS PRECAST CONCRETE SLABS AS MAIN INCLINED MEMBERS

hoisting engine. A portion of the backfilling was done by means of a 6-in. centrifugal pump, belt-driven by electric motor, which brought sand from the ocean at points near the front of the wall. The entire driving rig was moved along as the work advanced, on 6-in. wooden rollers.

The demolition of the old parapet wall was carried out by blasting with small charges of powder placed in holes drilled in the face of the concrete near the sidewalk line. A battering ram used for completing the work of demolition is shown in the illustration suspended from a traveler built on the driving rig. The old wall was broken up just in advance of the placing of the slabs.

The design was prepared jointly by the city engineer of Long Beach and Henry Schlueter, Los Angeles, who has patented the concrete slab construction used. The work was started Feb. 10, 1918, and completed July 22, at a cost of $111,775 for 1706 lin. ft., or $65.45 per linear foot. The contract was held by the Ross Construction Co., Sacramento, Cal.

Fire-Resisting and Wood Offices Built At Same Time

Government Gets Relative Figures on Cost of Buildings Put Up Under Direction of Army in Washington

OPPORTUNITY for comparing speed of construction and cost of wood-frame temporary office buildings with those of reinforced-concrete buildings was afforded this spring and early summer in the construction simultaneously of three additional office buildings to the large group which now extends along the Mall in Washington, between 4½ and 8th Sts. The buildings were put up by the Construction Division of the Army on force account, and accurate cost figures were kept. The wood-frame buildings approximated $2.45 per square foot, whereas the reinforced-concrete and tile buildings cost about $3.48 per square foot.

The three buildings, to be used by the Signal Corps, the Surgeon General's office, and the Ordnance Department, are in Henry and Seaton Parks in Washington. They have a total floor area of about 850,000 sq.ft., provide office space for 6250 persons and in an emergency for 8000. Each of the buildings is three stories in height. No general contractor was employed. The whole work was supervised by officers of the Construction Division, under the direction of Col. (now Gen.) R. C. Marshall, Jr. Contractors were used on some subcontracts. Skilled and unskilled labor was obtained through the Civil Service Commission, and little difficulty was found in keeping the supply sufficient. The main reason for erecting the three buildings by direct labor was to provide the division with a measuring stick for gaging the work done by private contractors under the so-called cost-plus form of contract with fixed maximum fee. It is stated that the officers are satisfied that this form is fair to both Government and contractor. The total cost of the buildings will be well within the $2,377,500 appropriated.

Building E for the Signal Corps was completed June 2, thirty-nine days after being started. It is three stories in height, of wood-frame construction, with a cement plaster exterior and plasterboard interior partitions. The total floor area is 330,000 sq.ft. The building is divided into eight separate wings by firewalls with automatic fire doors, and has a complete system of fire protection—fire extinguishers, chemical fire engines, automatic and hand-operated fire alarms—and a fire and police system. In the construction of the building there were used 2,500,000 ft. of lumber, 650,000 ft. of wall board, 5000 bbl. of cement, 1500 squares of roofing and 25,000 yd. of plaster. The total cost of the building was $782,500, or $2.40 per square foot. A maximum of 1700 men was employed in the construction, the average number per day being about 1112. Mechanics were paid on an average 70c. an hour and common labor 35c. an hour.

Building F for the Surgeon General's department is identical in its detailing with Building E, and the labor rates during its construction were the same. It was started Mar. 22 and finished May 1; that is, 39 days, with 24 working days, omitting Sundays and days lost by reason of inclement weather. The average number of men employed was 939, and the maximum at any one time was 1500. The building is divided into seven wings by firewalls, and has the same complete fire protection as Building E. In the construction there were used 2,000,000 ft. of lumber, 450,000 sq.ft. of plasterboard, 4500 bbl. of cement, 1200 squares of roofing, 1500 sq.ft. of metal lath and 18,000 yd. of plaster. The total cost was $674,500 for the 275,000 sq.ft., or about $2.46 per square foot.

Building G was used for the engineering division of the Ordnance Department, is of beam-and-girder reinforced-concrete frame, concrete and tile floors, tile walls with stucco-plaster exterior and sand-coat-finish plaster interior. It was begun on Mar. 21 and the building was ready for occupancy June 2; that is, in 72 days. The average number of men employed per day was 620, the maximum number being 1100. The building has a total floor area of 242,000 sq.ft., and its total cost was $842,900, or $3.48 per square foot, the same rates of wages being paid to laborers and mechanics as in the other two buildings. Except for a sprinkler system, it has the same complete fire protection as the other two. In the construction of the building there were used 180 carloads of building tile, 16,000 bbl. of cement, 10,000 yd. of sand and gravel, 500,000 ft. of lumber, 450 tons of reinforcing steel, 900 squares of slag roofing and 37,000 sq.yd. of plaster Steel window sash was used throughout.

Heavy Mallet Locomotive For Norfolk & Western

A Mallet locomotive with a weight of 535,000 lb. without tender or 747,000 lb. with tender has been built for the Norfolk & Western Ry. There are eight drivers on a side, with a total driving wheel base of 57 ft. 4 in. The weight on the drivers is 472,000 lb. The weights on the leading truck and trailing truck are respectively 28,000 and 35,000 lb. The total wheel base is 92 ft. 11¼ in. The tender, which weighs 212,000 lb., has a water capacity of 12,000 gal. and a coal capacity of 20 tons. The locomotive has a tractive effort of 04,300 lb. compound or 135,600 lb. simple.

Construction Plans Developed for the Bronx River Parkway Reservation

Designs of the Park Commission Contemplate Development of 1400 Acres by Grading and Planting—Numerous Structures Are Proposed—Work To Be Done by Day Labor

BY L. G. HOLLERAN
Principal Assistant Engineer, Bronx Parkway Commission

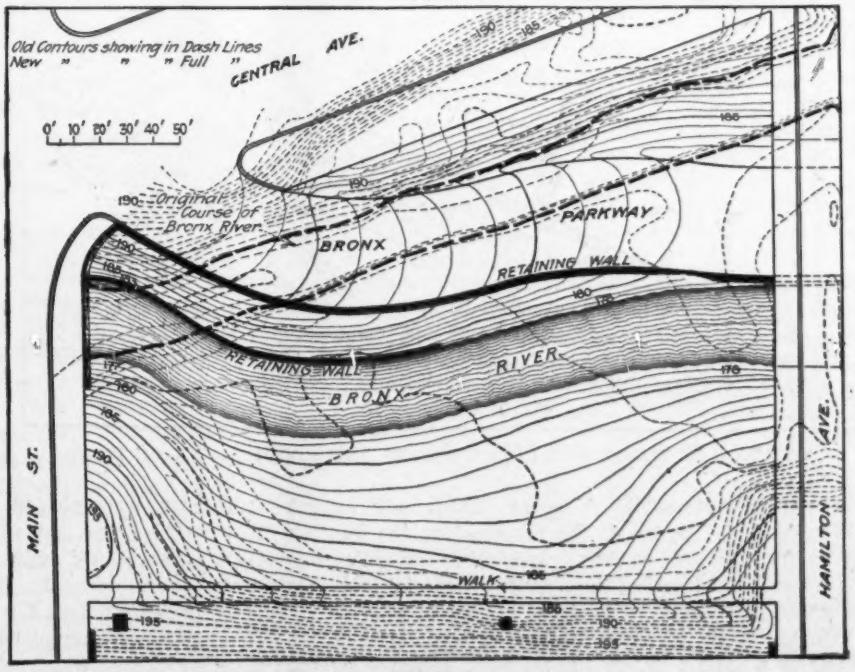
THE development of the Bronx River Parkway Reservation, covering an area of 1400 acres and extending for 15 miles along the river in a northerly direction from the New York City limits, contains many interesting problems. The main features of the scheme contemplate the relocation of the river, with regulation of its flow, and regrading and replanting the entire area. The magnitude of the work may be seen when it is stated there will be, when completed, 20 miles of automobile driveway 40 ft. wide, 35 miles of footpaths, 28 bridges, three viaducts, 69 foot bridges and six dams. To design and carry out this work properly, extensive topographical, grading and planting plans were developed. Nurseries holding 60,000 young trees and shrubs at one time were started to provide for replanting, and special machinery was provided to carry on the work. After extended inquiry, it was decided to do the development work by force account, and let the structures only by contract.

During the ten years previous to 1907, officials and citizens of New York City, and also of Westchester County, considered with increasing concern the problem presented by the polluted condition of the Bronx River, the longest river within the city limits and the most picturesque. It was recognized that the purity of the stream and the beauty of its surroundings could not be preserved without comprehensive measures of protection and preservation. Various suggestions were made for conducting the entire river through enormous conduits, but this was found to be impracticable owing to the difficulty of building a conduit large enough to carry the flood run-off, and also on account of the huge cost, estimated to be in excess of $10,000,000. With the passage of time, however, this problem began to press more urgently for solution, and in 1907 an act known as Chapter 594 of the Laws of 1907 was passed by the legislature of the State of New York. It provided for the appointment of a permanent commission to acquire the necessary lands to carry out the parkway project. The act also set aside for public use an area extending for about 15 miles along the banks of the Bronx River from the northerly boundary of Bronx Park in the City of New York to the city's lands acquired for water-supply purposes at Kensico Reservoir in Westchester County, including principally the low lands on either side of the river, varying in width from 200 to 1200 ft., with an average width of 600 ft. This area, with the public streets and other public lands within or along the reservation, and the water-supply lands below the Kensico Dam, aggregates about 1400 acres.

The terms of the act provide that three-fourths of the cost of this project shall be paid by the City of New York, and one-fourth by the County of Westchester. Commissioners were appointed by Governor Hughes in 1907, and in June, 1913, after some amendatory legislation had been passed, the first appropriations for the acquisition of the lands were made available. About two-thirds of all the lands were acquired by private purchase, and the remainder are being taken by condemnation.

The engineering and construction activities of the commission can be classed under the following heads, each of which will be briefly discussed: Surveys; preparation of landscape development plans; preparation of grading plans; preparation of planting plans; river regulation and its relation to other features of the development; design of structures; work of construction.

The property within the reservation which it was



OLD AND NEW CONTOURS AND NEW LOCATIONS OF RIVER AND PARKWAY SHOWN ON GRADING PLAN

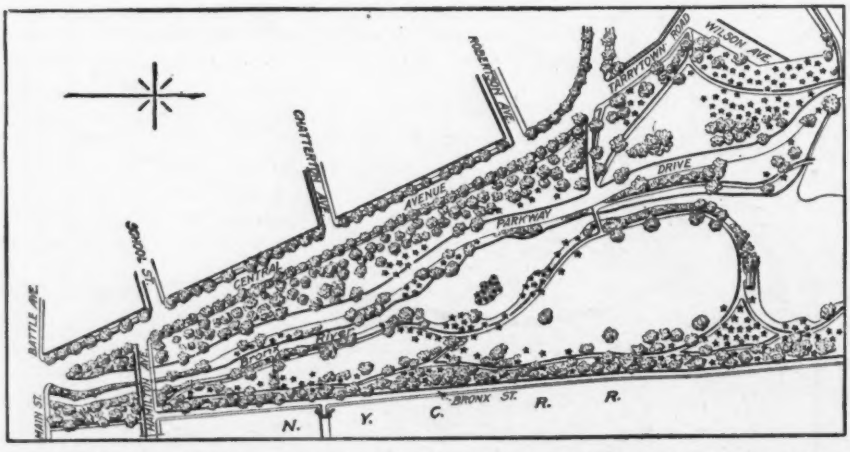
found necessary to acquire contained about 1300 separate parcels. These parcels are shown on 30 real estate sheets 24 x 36 in. in size, to a scale of 1 in. = 100 ft. As the commission had only the nucleus of an engineering organization when preparation of property maps was started, it was deemed best, in order to push the work forward as rapidly as possible, to employ local engineers and surveyors to make property surveys and prepare the original maps.

By the time the property surveys were completed the commission had organized a small engineering force and topographic as well as all succeeding surveys have been made by this force, which has been increased from time to time as the work under way demanded. In order that the succeeding grading and planting plans could be laid out with the required accuracy, it was decided to plot the topographical maps on a scale 1 in. = 20 ft. horizontal, with 1-ft. contours. Contour and level shots were obtained by the transit and stadia methods, and the location of trees, walls, fences and buildings was made by the transit and tape.

The experience gained in preparing grading and planting plans leads to the conclusion that if topography, grading and planting had been plotted to a scale 1 in. = 40 ft., with 1-ft. contours, the resulting slight decrease in accuracy would have been more than counterbalanced by the increased convenience in use of the maps in field and office, as with a scale as large as 1 in. = 20 ft. a comparatively small area can be shown on the largest-sized maps which can readily be used.

As the topographical plates were completed, they were turned over to the commission's landscape architect and forester, who, in conjunction with the engineering forces, made a careful study for the relocation of the Bronx River, which in many places flows along the margin of the reservation; the location of the parked automobile driveway which will extend throughout the length of the reservation; the location of paths, bridges, viaducts and other miscellaneous structures. In locating these features special care was taken to preserve existing trees as far as possible.

On the basis of these studies, colored development plans to a scale 1 in. = 100 ft. were prepared by the landscape architect, showing the general features of the development and an outline of the reforestation and planting. A reproduction of one of the commission's development plans is shown.



LOCATION OF TREES, SHRUBBERY, DRIVES AND RIVER SHOWN ON PLAN

Grading Plans

After landscape development plans had been completed tentative grading plans were prepared which showed the changes in contour necessary to carry into effect general features of the development work. These plans were made to a scale 1 in. = 20 ft. horizontal with 1-ft. contours, the same as the topographical plates. These tentative grading plans were then studied with reference to the availability of grading material.

The earth-work quantities were estimated, and, following approximately the procedure used in railroad and highway work, mass diagrams showing balances and deficits between cut and fill were plotted. As a result of this analysis, grading plans were revised until an efficient balance, which would eliminate long hauls, was secured. An important purpose of these studies was to avoid, as far as possible, the borrowing of grading materials beyond the reservation limits. Final grading plans, showing finished contours and all landscape features, were then prepared, from which construction work was staked out by the field parties. A reproduction of one of the grading plans is shown.

Planting Plans

The reforestation of denuded areas is of the first importance, and the efforts of the commission will be directed to the restoration of the native beauty of the valley by replacing, as far as possible, the original flora of the region. Nurseries have been established on the reservation, and about 60,000 young trees and shrubs are growing in them. During the past season a large number of the young trees have been removed and planted in various places where grading was sufficiently advanced to make such planting possible. Much screen planting will be required along high railroad embankments and in other unsightly sections, but indiscriminate mixtures will be carefully avoided in the planting. When the grading plans for any section were completed, the skeleton work of such grading plans, showing the location of the river, driveway, paths, etc., was traced, and the existing trees, which had previously been located on the topographical plates, were plotted on these skeleton plans. The new planting was then filled in according to the general planting procedure outlined above. Tabulations on separate sheets were also made, showing the number of each species required for the area to be planted. When these plans were completed, they were turned over to the planting force, which obtained the necessary young trees from the nursery and carried out the planting.

A reproduction of one of the planting plans is shown in the cut.

The Bronx River is the fundamental feature which controls the engineering and construction problems and to a large extent the physical improvement and landscape development of the reservation. The flooding of the marginal lands and low-lying sections of the reservation is typical of the problem offered by many rivers.

From these studies the proper profile for deepening the channel was determined at all points, as well as the normal water-surface elevation, and when the river improvement has been completed the water will be held at nearly constant levels during the greater portion of the year.

The purely æsthetic element was also kept in mind. Natural slopes and banks were left undisturbed where

IMPROVEMENT ADJACENT TO RIVER ATTAINED BY GRADING AND PLANTING: BEFORE AND AFTER

To avert destruction of property and large losses, the conservancy district idea has been evolved and applied; as, notably, on rivers in the Middle West.

Somewhat analogous is the Bronx River Parkway Reservation, which may be considered as a conservancy district on a small scale. The river flows through Bronx and Westchester Counties, and through various municipalities. It would be quite useless to improve it in any one section and neglect the others. It was, therefore, necessary to study it throughout its entire length, and one basic object of the work of river regulation was to prevent frequent flood overflows. In order to prevent the intermittent flooding of marginal lands, except at periods when such flooding would cause little or no injury—as in the very early spring when the reservation will be little used—the best solution for the Bronx River is, unquestionably, the deepening and widening of the channel and using of the dredged materials for raising the banks.

Improvements in Bronx River

Jurisdiction over the river throughout its entire length enabled the commission to adopt comprehensive plans. The details of these plans vary with the topography of different sections, but, in general, the river is being widened and lowered by deepening the channel, removing obstructions, and, where necessary, lowering the crests of existing regulating dams. Studies were made of all available stream-flow records of the Bronx River, and long term stream-flow records of the Croton River. The latter records were considered to be applicable, since the Bronx River and the Croton River have similar watersheds, rainfall and other characteristics. Gaging stations and stations for taking stream-flow records by current meter measurement were also established by the commission, and measurements were made at various stages of the river level and flow.

possible, since straight slopes and a canalized channel would not in any sense be appropriate in park development. These river channel improvements will serve three purposes: First, the reclaiming of low lands by eliminating flood overflow; second, the securing of a sufficient depth of water for the development of swimmining pools and water sports, and, third, the obtaining of sufficient material for use in grading the marginal lands in order to supply the proper landscape development.

River Problem Considered

There is a fall in the river of about 150 ft. between Kensico Dam and Bronx Park, so that in order to provide stretches of slack water for canoeing, swimming and other water sports it will be necessary to construct occasional low dams with spillways of sufficient length to carry the flood flow. The use of automatic crests which will operate under flood conditions has been considered, and tentative designs have been prepared, but no satisfactory solution of this problem has yet been reached.

In the development of the reservation, designs have been prepared, or are in course of preparation, for about 20 miles of automobile driveway. For the greater part of its length this driveway will be 40 ft. in width, but in some locations it will be separated into two 20-ft. drives or one 30-ft. and one 20-ft. drive. Thirty-five miles of paths, from 4 to 12 ft. in width, 28 driveway bridges, three viaducts, three railroad crossings, 69 foot bridges, six dams, and other structures such as retaining walls, changes in sewers, drains, etc., will also be constructed. Standard designs for driveway drainage structures have been adopted where possible. In the design of the bridges, competent architects have been consulted in order to provide architectural treatment which will harmonize with the parkway development.

The dams will be low in most cases, and the prin-

cipal feature requiring skill in design will be the automatic crest. Great care has been taken in the design of retaining walls and similar structures, in order to have them harmonize with their surroundings.

As soon as the lands were acquired, buildings and other incumbrances were cleared away, the lands and river channel were immediately cleaned up, and action was taken to abate the pollution of the river. To extend public use, certain development and construction work was necessary. A construction program was laid out early in the season of 1916, and such funds as were available for carrying it out have been used for the purpose since that time. Experienced contractors were consulted, and inquiries were made to find, if possible, contractors with suitable plant who were willing to bid on the work. Tentative specifications for river excavation were drawn up, and were made as simple as possible in the hope of obtaining proposals. Informal bids received were considered too high.

This condition was probably due to the peculiar difficulties attendant upon awarding contracts for park work. Stripping and stacking top soil, protecting trees and other landscape features, are matters which do not especially appeal to the contractor engaged in doing work at a fixed price per cubic yard.

The commission appreciated the difficulty in obtaining the best results for river regulation work and grading at a reasonable cost, if done by contract methods. In order to confirm its views, if possible, a series of questions was sent to the park boards or executives in charge of the principal park and parkway systems throughout the United States. The questions were framed to disclose the comparative advantages and disadvantages of the contract system as compared with day labor for parkway grading and landscape improvement work. The majority of the answers showed that on work of this character the contract system has given unsatisfactory results.

Day Labor and Contract Methods Adopted

This investigation confirmed the conclusion that the fundamental work of river regulation, grading, top soiling, planting and general landscape improvements could best be done by day labor under direct supervision of the commission's engineers and landscape experts. To avoid the necessity of purchasing expensive plant and developing an organization of highly skilled workmen, necessary for erecting bridges and the construction of sewers, pavement, buildings and similar structures, the policy adopted provided for doing such work by the contract method.

Upon undertaking the river improvement work, it was found necessary to consider the types of machinery best adapted to existing conditions, which included low-arch bridges, many overhanging trees which must be preserved from injury, and the fact that much of the work is "wet excavation," which cannot be handled satisfactorily, either by hand labor or by some types of excavating machinery. An investigation was therefore made by the commission's engineers, covering the types of machinery in use throughout various parts of the country on work of a similar nature. This investigation included an inspection of steam shovels, draglines, cable ways and various other classes of excavating machinery, as well as investigation of pumping and hoisting apparatus.

These investigations resulted in a special type of ladder dredge being developed by the Bucyrus Co., of South Milwaukee, Wis., for use in the heavily wooded sections along the river, where a machine of swinging-boom type could not be used. This machine requires very low head room, and the floating hull on which it is mounted draws only about 2 ft. of water. The machine consists of continuously operated ladder buckets, dumping into a hopper leading to a belt conveyor, which places the dredged materials on the river bank. This conveyor can be shifted so as to avoid injuring the trees. The dredging machinery is operated by a 20-hp. electric motor, and the conveyor is operated by a 5-hp. electric motor. Electric power is obtained from a local lighting company, and the cost of operating the dredge is about $25 per day, including depreciation on plant. The capacity of the machine is about 100 cu.yd. per day.

Cost of Operating Excavator

For use along open stretches of the river where a swinging boom can be used, a Monighan 1-T walking dragline excavator was purchased and used during the 1917 construction season. This machine is equipped with a 35-hp. Westman gasoline engine, a 40-ft. boom and a 1-cu.yd. Page scraper bucket. The machine worked two shifts during the greater part of the season, and in 333 working shifts (this includes all working days except Sundays and holidays irrespective of whether the machine was actually operating or not), 71,717 cu.yd. of material were excavated or rehandled; an average of 215.4 cu.yd. per shift. The cost of operating this machine for the season was $11,967.07, including depreciation, so that the cost per cubic yard was about $0.16⅔. During a portion of the season the machine was used for loading wagons and a hopper was constructed for doing this class of work. A cost of $0.318 per cubic yard was obtained for loading, hauling and spreading material by this method.

During some portions of 1916 and 1917 a Keystone excavator was also used for excavating and loading teams. This machine was rented by the day, and in general proved very useful in this class of work, where the digging was clear earth without an admixture of roots or stones of any considerable size.

During the seasons of 1916 and 1917 the commission had on its payroll a labor and maintenance force of about 200 men, and an average of from 15 to 20 teams, and general grading work, grading of paths and driveway and miscellaneous construction work was in progress at many points by team, scraper and hand-labor methods, in addition to the excavation by machinery. The war reduced the labor force materially.

Besides the work done by its own forces, work on six construction contracts, covering pavement of driveway; construction of two reinforced-concrete highway bridges; construction of a reinforced-concrete viaduct across the reservation; diversion of the Bronx River and sewer connections in the City of White Plains, and telford pavement for a subsidiary drive, have been in progress. At the end of 1917 the commission's development work was well under way, and satisfactory results of the careful planning outlined above had

begun to show in many sections of the reservation. On account of the need for laborers in war work the construction was greatly cut down during 1918.

The engineering and constructing work of the commission is being done under the supervision of Jay Downer, engineer, who is also the secretary of the commission, and acts as its general executive officer. Chester A. Garfield is field assistant engineer and Hermann W. Merkel is consulting landscape architect and forester.

Many Tests Made in Study of the Concrete Ship

Emergency Fleet Corporation Investigates Shear in Concrete, Effect of Repeated Loading, and Oil-Tightness

CONCRETE-SHIP design and behavior are dependent on a number of physical properties of reinforced concrete which heretofore have not been as clearly understood as they ought to be. In the study of the designs of the new Government concrete ships, the concrete ship department of the Emergency Fleet Corporation has been making a number of physical tests, mainly on approximately ship-size specimens, which will tend to clear up some of the obscure points in issue. Several of these tests were described by R. J. Wig, head of the department, in a paper presented before the Society of Naval Architects and Marine Engineers at Philadelphia Nov. 14.

The investigations were made to establish safe working stresses and standards of design. Tests already made demonstrate the safety of the designs first made, and indicate how weights may be further reduced without sacrificing strength. The structural investigations are made under the direction of W. A. Slater at the Bureau of Standards' laboratories in Washington and Pittsburgh, the laboratory of Lehigh University at Bethlehem, Penn., and the Office of Public Roads, Arlington, Va.

One of the first serious difficulties in the designing of concrete ships was that of getting sufficient strength to prevent cracks forming diagonally in the vertical sides of a ship of practicable weight. Using the methods ordinarily employed in reinforced-concrete design, a shell thickness of at least 15 in. would have been required instead of the 4 in. used in the 3500-ton cargo ship. Tests of large reinforced-concrete beams were started to make certain that no mistake was being made in using a 4-in. shell. These first tests were made on (a) beams 4 ft. 4 in. deep and 18 ft. 6 in. long; (b) one beam 10 ft. deep and 28 ft. long; and (c) specimen ship frames of full-size cross-section and 20-ft. span. The frames were cut off at a point corresponding to the point of inflection, or 4 ft. 6 in. above the top of the keel. The tests were made in the 10,000,000-lb. testing machine at the Bureau of Standards, Pittsburgh.

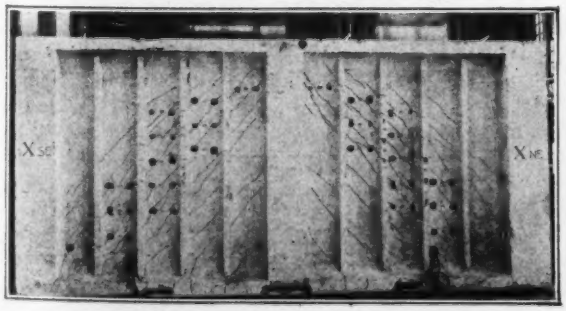


FIG. 1. BEAM 10 FEET DEEP AND 28 FEET LONG TESTED WITH LOAD ABOVE

For the beams the load was applied at the center of the span upon the upper flange. The beams were supported at each end on a steel plate girder. The beam, 10 ft. deep, was first loaded forty times with 640,000 lb., which was four times as much as the maximum which the standards of the Joint Committee on Concrete and Reinforced Concrete would have allowed as its working load. The widest crack at the first application of this load was 0.013 in., and, with forty repetitions of the load, there was no appreciable increase in the widths of the cracks. The beam was then inverted, and load was applied in the opposite direction, causing failure at 1,363,000 lb., or nine times as much as the Joint Committee standards for reinforced-concrete design would have allowed as a working load.

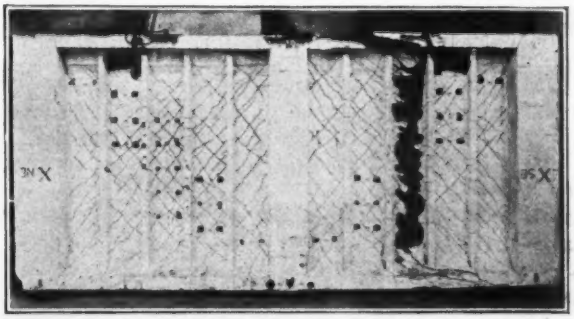


FIG. 2. BEAM SHOWN IN FIG. 1 WITH CRACKS FROM LOAD ON BOTH UPPER AND LOWER FLANGES

Fig. 1 shows this beam after it had been loaded from one direction. The cracks were painted to make them visible. The holes and channels cut in the concrete exposed the reinforcement to allow measurements of change of length of the bars to be made. Fig. 2 shows the beam after completion of the test in an inverted position. The cracks formed in this test were approximately at right angles to those due to the first test. This view also shows the manner of failure.

The ship frames were tested by applying, first, only a vertical load, and adding later a horizontal load at the sides corresponding to the horizontal water pressure on the sides of the ship. It was found that the strength here was about eight times as great as the Joint Committee recommendations allowed for the working load, also that the shear due to the horizontal forces reduced the stresses set up by the shear due to the vertical forces; in other words, that the horizontal water pressure would reduce the stresses caused by the vertical shearing forces on the frame. Fig. 3 shows the frame in the testing machine.

These tests have made it possible to design with confidence, using working shearing stresses much higher than those which are recognized by the last report of the Joint Committee for structural members of ordi-

nary design and proportions. However, it has not been necessary as yet to use working stresses as high as appear from the tests to be justified. The working stresses in shear, for instance, used by the department are:

Maximum unit shearing stress *V/bid* in T-beams and in shell or other slabs, 500 lb. per square inch; in isolated beams, 300 lb. per square inch.

When the maximum unit shearing stress is less than 50 lb. per square inch, the concrete may be considered to carry all the shear.

When the unit shearing stress is greater than 50 lb. per square inch, reinforcement should be provided as follows: (a) In the design of thin slabs, used as the webs of beams, with the shearing action perpendicular to any local shearing stress such as the shell, provide shear reinforcement according to a formula for combining shear and local stresses; (b) in all other cases provide shear reinforcement to carry the full amount of the shear.

Tests are under way to determine the effect of rapidly repeated loads on a reinforced-concrete beam. A beam supported in a frame has a motor operating a lever in such a way as to apply a known load to the beam alternately upward and downward at the rate of about 36

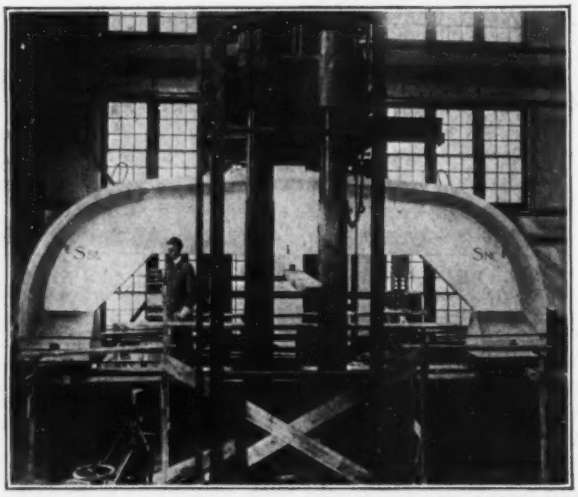


FIG. 3. SPECIMEN SHIP FRAME IN TESTING MACHINE

load applications (18 complete cycles) per minute. The tensile stress developed in the steel is about 23,000 lb. per square inch and 746 000 applications of the load had been made up to Aug. 18. There had been no perceptible increase in the strain in the steel or the concrete after 1000 applications of load, and very little increase between the first and the thousandth application. Cracks appear in the lower portion of the beam under downward load, and in the upper portion under upward load. The largest cracks, on Aug. 18, were about 1/100 in. wide. With continual opening and closing of cracks, if any should occur in the alternate hogging and sagging of a ship, the possibility of a grinding action on the fractured surface has been considered as a possible destructive agency, but thus far in the test no such grinding has been observed.

During the making of all large test specimens, small specimens of concrete have been made using the same material as that going into the large specimen. The compression tests of the small specimens show strengths as great as the assumed strength on which the working stresses used in design were based.

In order to determine whether in the complicated network of reinforcement present in the ship structure the quality of the concrete could be made satisfactory, special tests were made. Slabs 4 in. thick, with a very large amount of reinforcement made up into a complicated network, were poured on edge to a depth of 3 ft. All parts of the structure were well filled out with concrete, covering all the reinforcement satisfactorily, and in the load test which was applied failure occurred by tension in the steel before the ultimate strength of the concrete was reached, although a stress of about 4400 lb. per square inch in compression in the concrete had been developed.

All the evidence thus far accumulated indicates that a concrete strong enough to warrant the use of a high working stress in compression (1500 lb. per square inch) can be obtained in all cases where sufficient attention is given to the placing of the concrete.

Tests are under way to determine the conditions under which leakage through construction joints and through cracks may be expected and how it may be prevented. Thus far hollow beams, having wall thicknesses of 4 in. and construction joints in which as much as seven hours elapsed between the pouring of successive layers of concrete, have been tested under a 30-ft. head of water. No leakage occurred through any of the construction joints, and apparently none through the side wall, except where the wall was penetrated by a steel tie-bar. However, leakage did occur through the thicker upper flange of the beam where imperfections in the construction occurred.

While under a pressure due to a 30-ft. head of water, the beams were loaded so as to give a shearing stress of 300 lb. per square inch. It was found that where a diagonal tension crack was as much as 0.002 in. wide, a small amount of leakage occurred, and where it was 0.004 in. wide the leakage was appreciable.

An inspection made by the United States Bureau of Standards in 1917 of reinforced-concrete oil tanks then in service indicated that mineral oils had no deleterious effects on concrete which was cured before contact with the oil. The series of tests now under way confirms this conclusion and shows that certain organic oils do have a destructive effect on the concrete used. The penetration tests are being made with oil under a maximum head of 16 ft. The penetration into 1:2:4 concrete for the lightest oil used (73.7 B.) was about 1.6 in. in 40 days, and for the heaviest oil (95.5 B.) it was about 0.27 in. Preparations are being made for tests under a head of about 25 feet.

Tests are under preparation to determine the relative advantages, for taking stress, of placing slab reinforcement parallel to and at an angle with the direction of the span.

In a beam having large variation in the area of the cross-section there is uncertainty as to how much of this area is fully effective in resisting the tensile and compressive stresses. Analysis indicates that if the entire area is available the use of properly designed haunches in ship frames may permit a reduction in the weight of ship frames of from 20 to 30 per cent. of the weight required on the basis of existing standards. A series of tests to obtain information on this question is now under way.

Variety of Equipment Used to Move Supplies for Drainage Ditch Construction

Motor Trucks Supply Main Camp from Railroad 25 Miles Away—Teams and Boats Take Supplies from Main Camp to Dredge Crew Camps—Heavy Hauling Done in Winter When Swamps are Frozen

FIFTY-YEAR-OLD lumber-camp methods of getting in supplies, and up-to-the-minute methods of earth handling by machinery, are contrasts furnished by drainage ditch construction practice in northern Minnesota. Camp supplies and fuel for dredges, hauled in winter over snow roads, are accumulated in storehouses and cachéd along the ditch lines. Camps are built of forest trees. Roads are cleared and graded along the ridges and corduroyed across swamp land. Bridges are built of timbers cut near the structure and hewn to dimensions. By the side of these pioneer structures work large floating and walking dredges operating on oil fuel and capable of digging 50,000

FIG. 1. DITCH SPOIL BANKS LEVELED AND GRADED FOR HIGHWAYS

cu.yd. of ditch every 30 days. The contrast does not indicate an anomalous condition. The country is a wilderness of forest and tamarack swamp and can be penetrated and opened up for modern machine construction methods only by the methods of the pioneer.

One of Minnesota's largest drainage projects, known as Judicial Ditch No. 25, lies in that part of Beltrami County between Lake of the Woods and Red Lake and bordering on the Rapid River. In the *patois* of the drainage man a "ditch" in Minnesota is any group or system of ditches which, in law, constitutes a single project. Ditch No. 25, therefore, is not a single ditch but a system of 250 miles of ditches and of as many miles of roads, for Minnesota grades the spoil banks of its ditches and makes highways of them. The total volume of excavation is more than 3,400,000 cu.yd. To prepare the way for moving this earth 1700 acres have to be cleared of trees, and 1000 acres have also to be grubbed. Construction will cost between $400,000 and $500,000.

Railways do not penetrate the wet lands of northern Beltrami County. Ditch No. 25 is nowhere nearer to a railway than five miles, and the main construction camp for the system is 25 miles by camp road from the receiving point by rail for supplies. Woods are everywhere, hardwood in heavy growth, with scattered balsam and pine, along the natural streams, and beyond this edging are the tamarack swamps, which are impenetrable except to a traveler on foot, and in summer are too wet and soft over wide areas for any travel. Work making ready for dredge ditching under such conditions becomes a heavy task. The forest and swamp have to be opened up by clearing and by building roads and camps.

Camp headquarters for construction operations on Ditch No. 25 are situated on Rapid River, about 25 miles from the railway. Log buildings house kitchen, dining room, bunk house, feed and warehouse, blacksmith shop, stables, offices, engineers' headquarters and superintendent's residence. Except for the window sash and roofing paper these buildings are constructed with axe and saw from the trees of the forest. The camp is headquarters and from it radiate all the activities which keep the scattered dredge and road-building outfits supplied with the things they need. It is linked up with the railway and the outside world by the main camp road.

Camp road construction was accomplished by primitive methods and tools. Except for a pile driver, and this was built on the job from timbers hewn from the forest trees, no appliances but the tools of the woodsman and pioneer were used. Where the ground was high a right-of-way was cleared and grubbed and roughly graded. Across the swamp areas corduroy was laid. About four miles of the 25 miles were corduroy construction. Tamarack poles cut from the right-of-way and the bordering woods furnished the material. Stringers of the larger poles were laid down and covered close with

FIG. 2. DREDGES TOW FUEL OIL TANKS

cross poles, some of the larger ones being split. Nine bridges were required, the largest being 80 ft. long. Native timber, cut from the woods nearby and hewed with broad-axes to shape, was used. These hewn timbers were assembled into trusses by the use of old

wire cable for the rods. Floors were built of cross poles hewn flat on top.

Supplies are hauled to the main camp and from there distributed to the gang camps and dredges. With the main camp road completed, a motor truck makes daily trips between camp and railway. Teams supplement the trucks, taking empty oil barrels to the railway and bringing back feed for the horses. For the first season's work a considerable portion of the supplies was hauled to the main camp and distributed from there by snow roads in winter. An important detail of this winter hauling consisted of carrying in and distributing fuel oil for the land dredges.

Fuel oil was hauled from railway to camps in 12-bbl. tanks and at camp was emptied into 50-gal. steel barrels. Each barrel was tested with an air pump before being filled, to insure against leakage. The filled tanks were then distributed along the ditch right-of-way, three barrels in a place, with plugs up. To prevent possible overturning when the ground thawed, the barrels were wired together. Leakage, by these precautions, was reduced to a very small quantity. Yardage of excavation determined the spacing of the barrels. During the first month's work, while frost yet prevailed, a barrel of oil was allotted to each 800 cu.yd. of ditch; for warm-weather work the allotment was a barrel to each 1000 cu.yd. Stored as described, there were placed 1200 bbl. of kerosene for 100 miles of ditch right-of-way, in addition to sufficient gasoline for starting the engines, with cylinder and lubricating oils and cup grease, for three land dredges.

Supplies, other than oil, for the land dredges, are hauled by team as they are needed. As the dredges cast up the spoil banks, their tops are leveled and graded to form roads. This road building follows the dredges as closely as is practicable. First the peak is plowed down. A grader is then used to level off the bank and make it possible for teams to bring supplies to the dredge. Later the road is finished by two large graders hooked to a 60-ton caterpillar tractor. From camp, woods roads reach the nearest available point and then the teams follow the spoil-bank roads.

Water carriage is found the most convenient method of getting fuel oil and supplies to the floating dredges. A steel oil tank holding 5000 gal. is mounted on a barge which is towed behind each dredge. In one instance the barge is eliminated and two oil tanks fastened together are floated behind the dredge. The tanks are each 7 x 20 ft. Similar tanks set along the right-of-way replenish the barge tank. Other floating-dredge supplies are transported by boats. Since the dredge ditch has to be dammed at intervals of about a mile to form the necessary flotation pools for dredge operation, all supplies have to be handled over several dams.

Motor trucks, flat boats and horse and ox teams exemplify the range of transportation methods on these isolated swamp drainage works. No roads exist. Ditch work proceeds at separated points scattered over a wide area and constantly changing. Until the ditches are dug far enough to afford waterways or to permit spoil bank roads to be completed, no ways are open for transportation except temporary woods trails. Over these trails only horse or ox teams can operate with success. Therefore, the first task of the drainage contractor is to work out a rather complicated transportation system for his supplies.

Ditch construction proper involves two principal operations; first, clearing and grubbing right-of-way, and, second, ditch excavation. Clearing and grubbing for Ditch No. 25 were carried out largely during the winter. The men lived in portable camps kept close to the work. Nearly all the timber and stumps removed from the right-of-way were burned; only the best logs and poles were saved. These were piled up along the right-

FIG. 3. CONSTRUCTION CAMPS RESEMBLE LOG SETTLEMENTS OF THE PIONEERS
(1) Superintendent Anderson Has the Only Residence with a Piazza; (2) Engineer J. C. Burk's Headquarters and Helpers; (3) General View of Headquarters Camp; (4) Assistant Engineer V. E. Crabtree and Inspector Dick Williams in Full Equipment

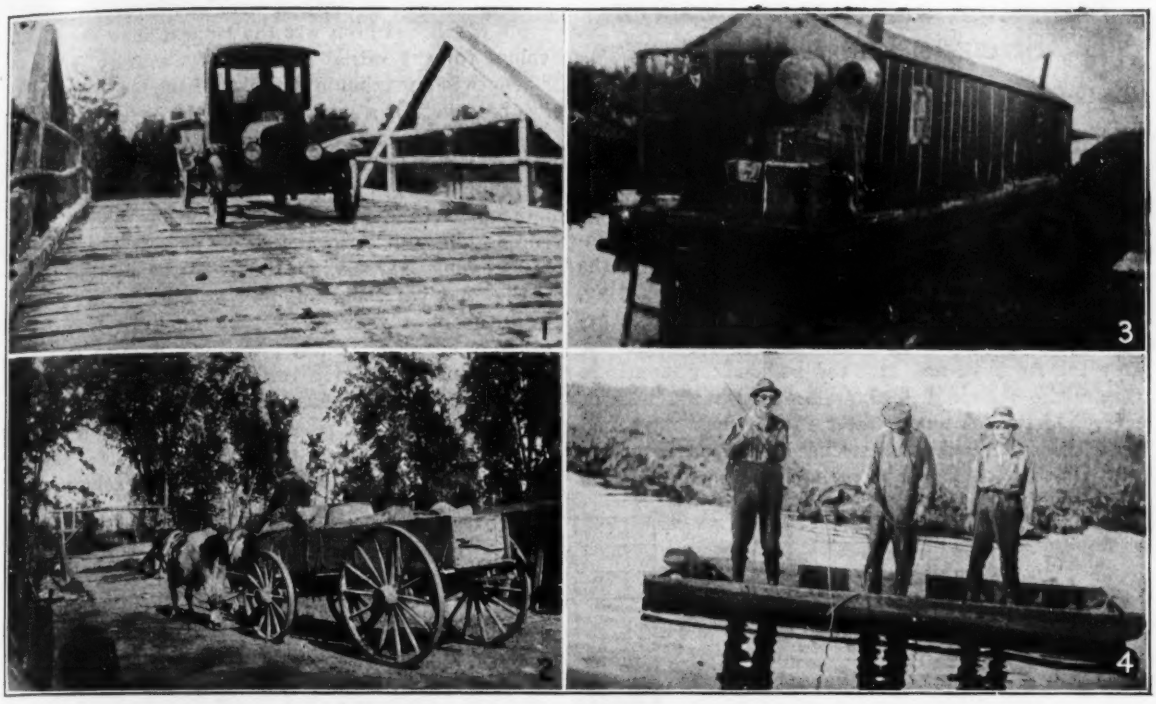


FIG. 4. FLAT BOATS, OX TEAMS AND MOTOR TRUCKS TAKE SUPPLIES TO DREDGE CREW CAMPS
(1) Bridges Built of Hewn Timbers and Old Wire Rope; (2) Ox Teams Only Means of Reaching Certain Camps with Supplies; (3) Dredge Crews Live in House Boats; (4) Flat Boats Take Supplies to Floating Dredges

of-way to be used later for temporary bridges and other construction purposes. Generally, in clearing, the stumps were removed by dynamite.

Six dredges are doing the ditching. Three of these are dry-land walking dredges and three are floating dredges.

Two of the dry-land machines are dragline dredges each equipped with a walking device and operated by a 60-hp. oil engine. The machines each weigh 50 tons. They each "walk" on three feet, two at the rear corners and one in front. Each foot is 10 ft. wide and 12 ft. long, so that the bearing areas of the three feet aggregate 51,840 sq.in. The load on the soil is, therefore, less than 2 lb. per square inch, which is so little that the dredges can ride all but the softest of swamp soils. These machines have excavated 1700 cu.yd. of ditch in a ten-hour shift. They are equipped with 1½-cu.yd. buckets.

The third dry-land machine is a walking dredge with a walking-beam shovel. This dredge straddles the ditch and is operated by a 40-hp. oil engine. The moving device is similar to those of the dragline machines. This dredge, traveling across country on its own feet, accomplished a journey of 13 miles in 4½ days. Its record is 329,000 cu.yd. of ditch in 6½ months.

One of the floating dredges has a 1-cu.yd. walking-beam shovel, but is otherwise of standard type. The other two machines are ¾-in.yd. dipper dredges of standard type.

Dry-land dredge crews are housed in tents, since frequent changes of camp are necessary to keep the men close to the work. The crews of the floating dredges live in a sleeping and cook cabin towed behind the dredge. When operating with full crews and with trained operators the six dredges have an output of 300,000 cu.yd. per month, but war conditions make it difficult to keep the dredges fully manned. It is planned to have the 250 miles of ditch completed in 1919, and to finish the road work the following season.

Judicial Ditch No. 25 is being built by the E. A. Dahl Co., Duluth, Minn., as contractor. V. G. Anderson is superintendent of construction and J. C. Burk is engineer in charge.

Grading by Stationmen on Alaska Railroad

For construction work on the Alaska Railroad the method of having the clearing and grading done by stationmen was adopted, the work being let directly by the Alaskan Engineering Commission, and no general contracts being awarded. Very little capital is required, as the commission furnishes the necessary equipment at a moderate rental, and the men can purchase supplies at the commissary, although this is not obligatory. A recent paper by Col. Frederick Mears, formerly a member of the commission, says it is particularly fortunate that this plan was adopted. Colonel Mears says: "Had the Government railroad, or any part of it been given out to a general contracting firm in 1915, when labor conditions were normal and prices for materials and supplies were low, it would have been impracticable for the contractor to have continued the contract in the subsequent years under the abnormal war conditions of high labor and material costs, without a very generous increase in the contract price. This would have resulted in delay for the consideration of claims, with a consequent loss of time and effort."

Saturation of Concrete Reduces Strength and Elasticity

Tests Show that Moisture Content of Specimens Serves to Counteract the Benefits of Moist Curing

By M. B. Lagaard
Concrete Engineer, Emergency Fleet Corporation, Philadelphia

THERE are three stages in the manufacture of concrete in which water enters as a vital element in the strength of the material. First, at the time of casting, when the materials are mixed; second, during the period of curing, when the concrete is in place; and third, after the concrete has attained sufficient strength to sustain the designed load. The danger of loss of strength from too much water in the first stage and not enough water in the second has been frequently brought to the attention of the engineering profession.

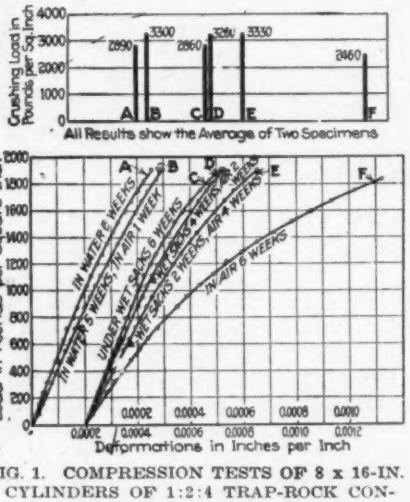


FIG. 1. COMPRESSION TESTS OF 8 x 16-IN. CYLINDERS OF 1:2:4 TRAP-ROCK CONCRETE AT AGE OF SIX WEEKS

However, the effect of the presence of water as a distinctly foreign element in concrete is a question upon which there are still very little published data, but of which clear knowledge must be had, in order to permit of the proper analysis of a concrete structure. Tests made in the experimental engineering laboratory of the University of Minnesota show that this continued moisture tends to reduce both strength and elasticity.

The tests were confined mostly to compression tests in which standard cylinders 8 in. in diameter and 16 in. high were used. Deformations were taken with a four-dial compressometer estimating readings to 0.0001 in. over a gage line of 10 in. The loads were applied in increments of 4000 lb. total, at regular intervals of time, the latter element having been recognized as a vital factor in the test of concrete specimens.

The curves shown in Fig. 1 represent the results of a series of compression tests of 1:2:4 trap-rock concrete specimens, made to show the variation in elasticity and strength of wet and dry concrete in the early stages of curing. All of the tests were made at the age of six weeks. It will be noticed that in all cases the specimens which had been wet the longest show the highest values for the initial modulus of elasticity, while the strength is a maximum with one of the specimens which has been wet for a short period at the beginning and has then been allowed to dry out before testing. Thus specimen E, which has been cured two weeks under wet sacks and four weeks in air, shows the highest strength value, although both A and B, cured in water, and C and D, cured under wet sacks for longer periods of time, show higher values for the initial modulus of elasticity.

Fig. 2 gives the results of another series of tests made about a year earlier, by an entirely different group of observers, where gravel was used as coarse aggregate instead of trap rock, but the results of which show the same peculiarities. The wet cylinder has the highest initial modulus, and one of the intermediate cylinders shows the greatest value for the ultimate compressive strength. Without considering the degree of saturation of cylinders at the time of test, the strengths should increase with the increased time of curing in water, and the values for the modulus should also increase accordingly. However, the fact that this does not take place shows that there is some other element to be considered which affects these two properties.

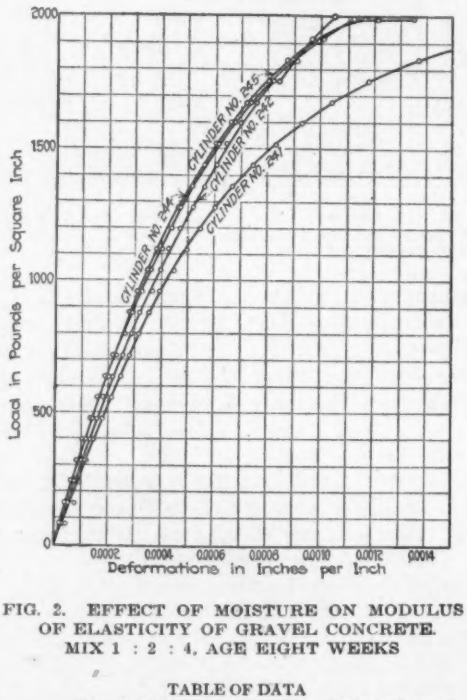


FIG. 2. EFFECT OF MOISTURE ON MODULUS OF ELASTICITY OF GRAVEL CONCRETE. MIX 1 : 2 : 4, AGE EIGHT WEEKS

TABLE OF DATA

Cylinder No.	Time in Weeks Under Sacks	Time in Weeks In Air	Secant Modulus at 700 lb. per sq.in.	Ultimate Strength lb. per sq.in.
241	1	7	2,530,000	1989
242	3	5	2,790,000	2434
244	7	1	3,000,000	2250
245	8	0	3,170,000	2069

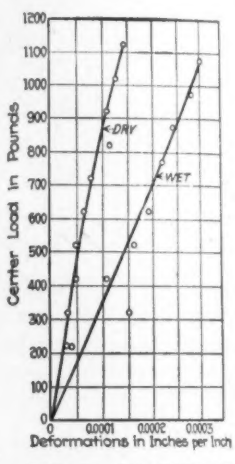


FIG. 3. TRANSVERSE TEST OF 4 x 4 IN. SOLID SANDSTONE BEAM. SPAN 22 FT.

The effect of this other element may also be noticed in the curves of Fig. 3, which show the results of a transverse test of a beam of solid sandstone. The readings in this case were taken with a 2-in. Berry strain gage directly over the load which was applied at the center. The tests were made under two conditions: First, when the beam was thoroughly dried, having been kept in a dry place for several years after quarrying; and second, after it had been immersed in water for a period of seven days. Here the question of age is of no

importance. The effect of water in the specimen at the time of test is at once noticed in the reduction of strength of the specimen. This appears to be exactly what has taken place in the concrete specimens of Figs. 1 and 2. The specimens which had been kept in water up to the time of test were thoroughly saturated and hence showed a much lower strength than would be expected with this curing, while those which had been cured under water for a period of time and then exposed to the air for various periods before testing were more or less dried out and hence did not show such a marked reduction. The specimens which were cured entirely in air were dry at the time of test and showed the normal strength expected. This variation in the percentage of moisture content is shown by the weights of the specimens given in the table. Thus the reduction in strength in any particular case appears to vary with the amount of saturation at the time of testing.

The same thing has occurred, in all probability, in the case of the initial modulus of elasticity, except that the reduction in modulus due to the presence of water was not sufficient to overcome the increase in modulus due to better curing.

The effect at advanced ages is shown in the curves of Figs. 4 and 5. Fig. 4 represents approximately the two extremes of the treatment shown in Figs. 1 and 2, extended over a much longer period of time, the wet cylinder in this case having been 189 days under wet sacks and the dry cylinder having been exposed to the air for the same length of time with the exception of the first two weeks, when it was kept under wet sacks. The results, however, are the same as in the case of concrete six weeks old, and point to the same conclusions.

Fig. 5 shows results from two specimens which were kept under wet sacks for seven days and then left open to the air for more than a year, after which one was placed in water for three weeks and then tested wet, while the other was tested at the same age dry. Both strength and modulus show a decided drop in the wet cylinder, the reduction in strength exceeding 35 per cent.

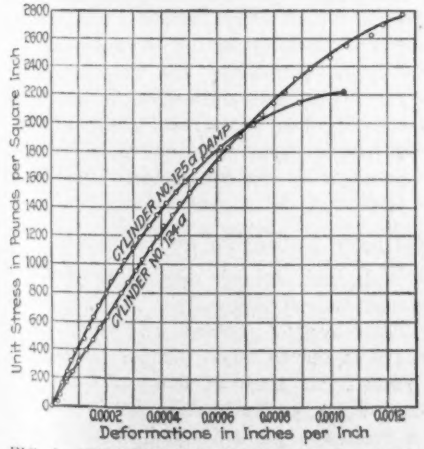


FIG. 4. COMPRESSION TESTS OF 8 x 16 IN. 1 : 2 : 4 LIMESTONE CONCRETE. AGE = 189 DAYS

Data: Cylinder No. 124a cured two weeks under wet sacks, then open to air of laboratory until tested. E = 3,078,000. Ultimate Strength = 3310 lb. per square inch.

Cylinder No. 125a cured under wet sacks until tested. E = 4,150,000. Ultimate Strength = 2480 lb. per square inch.

Results from another group of cylinders are shown in Fig. 6. In this group specimen No. 1129a was kept wet from the time it was cast, No. 1129c was kept dry after first being under wet sacks for a week, and No. 1129 was cured in the same manner as No. 1129c, except that it was placed in water the last 12 days and tested wet. The difference between 1129a and 1129 is in the curing, the effect of which shows up in the lower values of both the strength and the modulus of the latter. Cylinders 1129c and 1129, being cured alike except for the last few days, show clearly the difference due to the presence of water, the wet one having both a lower strength and a lower modulus.

TABLE SHOWING COMPARATIVE WEIGHTS OF 1 : 2 : 4 TRAP-ROCK CONCRETE, AGE SIX WEEKS

Mark	In Water	Under Wet Sacks	In Air	Weight Lb. per Cubic Foot
A	6	..	..	160 7
B	5	..	1	159.2
C	..	6	..	160.5
D	..	4	2	158.0
E	..	2	4	156.9
F	..	..	6	154.5

The outstanding features which the writer has observed in regard to these tests are enumerated below:

First, moisture in concrete reduces its strength and modulus of elasticity. This is in accord with the results found by Prof. J. L. Van Ornum in regard to strength, as reported in the *Transactions* of the American Society of Civil Engineers, Vol. 77, December, 1914.

Second, the effect upon the modulus is not as pronounced as the effect upon the strength.

Third, the reduction in strength due to saturation by water which has been present in concrete from the time of casting may be more than sufficient to overcome the increase in strength due to better curing.

Thus we find it possible to have two concrete specimens having the same modulus of elasticity and yet differing widely in ultimate compressive strength, and vice versa. The effect of this will be seen by referring to specimens No. 125a and 124a of Fig. 4 and applying

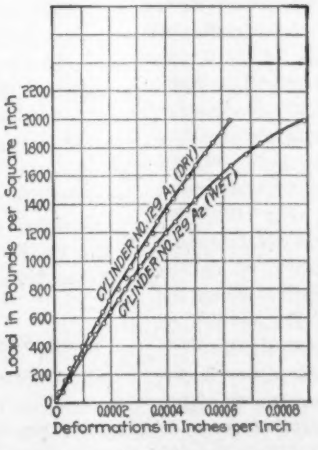


FIG. 5. EFFECT ON ELASTICITY OF MOISTURE SHOWN BY TESTS ON 8 x 16-IN. 1 : 2 : 4 LIMESTONE CONCRETE

Data: Cylinder No. 129A. Age = 469 days. Cured 7 days under wet sacks and 462 days in air. E at 600 lb. per square inch = 3,700,000. Ult. Comp. Strength = 3630 lb. per square inch.

Cylinder No. 129 A2. Age = 462 days. Cured 7 days under wet sacks, 434 days in air and 21 days in water. E at 600 lb. per square inch = 3,150,000. Ult. Comp. Str. = 2340 lb. per square inch.

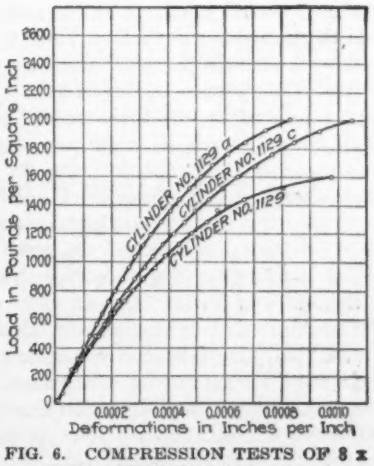


FIG. 6. COMPRESSION TESTS OF 8 x 16 IN. CYLINDERS, 1 : 2 : 4 LIMESTONE CONCRETE

Cyl. No.	TIME IN DAYS Under Wet Sacks	In Air	Under Wet Sacks	Age	Strength, lb. per sq.in.
1129-a	102	....	....	102	2150
1129-c	7	95	....	102	2350
1129	7	90	12	109	1670

to each the method for determining the modulus of elasticity outlined by the Joint Committee on Concrete and Reinforced Concrete in 1917. According to this method Cylinder No. 124a would fall in class D with a modulus of 3,000,000, which is very nearly the true value found by actual measurements, while Cylinder No. 125a would fall in Class C with a computed modulus of 2,500,000, whereas the measured modulus is about 66 per cent in excess of this amount. Subsequent drying would no doubt have put the latter specimen high into Class D, while saturation would in all probability have dropped Cylinder 124a into Class C, thus reversing the original condition.

From these results it is seen that the effect of saturation clearly must be recognized in an analysis of test data, and if reductions in strength as high as that shown in Fig. 6 can be expected in practice, the possibility of such a weakening must be taken into account in the design.

The writer wishes to express his appreciation to Prof. F. R. McMillan of the University of Minnesota, now in charge of extensometer tests of concrete ships for the United States Emergency Fleet Corporation, for the loan of data and for suggestions and assistance in the making of these tests.

Milwaukee Sewer Tunnel Contract Defaulted

CIRCUMSTANCES leading to the abrogation of a contract, resulting in the present suit and countersuit over the Harbor Entrance sewer tunnels at Milwaukee, Wis., are outlined as follows in the recently issued fourth annual report of the Sewerage Commission:

Contract No. 19, covering the construction of two conjoined inverted siphons under the rivers near the Harbor Entrance, was awarded Sept. 14. 1916. The time for the completion of the work was later extended from May 11 to Sept. 1, 1917. On June 14, 1917, the chief engineer reported to the commission that upon lowering the air pressure, cracks and leaks had appeared in both tunnels, and that on June 3, when all pressure had been removed, several cracks $\frac{1}{16}$ in. wide entirely around the tunnels had developed. Immediately work was begun repairing these cracks and was continued until June 8, when all work was stopped. Notification was given the contractor to resume repairs, which the contractor did, continuing work until Sept. 4, when the concrete floor in the construction shaft at the foot of Erie St. blew up, flooding the shafts and the tunnels under the Harbor Entrance and the Milwaukee River, with mud and water. Immediately after the flooding, the ground around the Erie St. shaft settled between 6 and 7 in. throwing the weigh-house of the adjacent incinerating plant out of commission. Upon occurrence of this failure it was decided to postpone granting an extension of the contract time to Nov. 15, which the contractor had requested on Aug. 24, awaiting the action of the contractor regarding the recovery and repair of shafts and tunnels.

Reporting to the commission Sept. 12, the chief engineer announced the failure as outlined above and stated that beyond one day's unsuccessful work trying to put the weigh-house scales in repair the contractor had done no work, and to all appearance had abandoned operations. At this meeting agreement was made with representatives of the contractor for a special meeting Sept. 18 to confer on ways and means.

At the meeting Sept. 18, the contractor, through attorney, presented a written statement. This statement, in brief, asserted that the conditions existing were in no respect directly or indirectly chargeable to the contractor or his work, and were due entirely to faulty and inadequate plans and specifications. It also maintained that certain work must be done before a resumption of the work under the contract could begin; that this work was expensive and in a measure dangerous, and that it was beyond the scope of contract No. 19. The contractor, it was asserted, was ready and willing to undertake the work intended to make it possible to resume work under contract No. 19, upon these conditions: (1) The city pay any and all sums due for work done under the contract; (2) the city pay for the work done in mending the cracks, and (3) the work necessary to be done before resumption of operations under the contract be regarded and agreed to be beyond and outside the scope of contract No. 19 and be paid for under that understanding. Specific definition of the preparatory work was not made.

Following the conference the Sewerage Commission formally notified the contractor to resume work in 10 days. To this notice the contractor replied, offering to eliminate conditions 1 and 2 named in the statement of Sept. 18, but did not define the work involved under condition three. Ten days having elapsed without resumption of work, the commission, Oct. 1, declared the contractor in default, and instructed the chief engineer to take possession of the work. Possession was taken and an appraisal was made of the construction plant and materials belonging to the contractor. A contract was then made with a new contractor to recover the tunnel and complete the work on a basis of actual cost plus 15 per cent.

Official information is not available concerning subsequent happenings. Construction, however, has proceeded and is now in progress under the new agreement. Meanwhile, the original contractor has brought suit against the city for $111,274.98 claimed to be due for work done, and the city has answered by a counterclaim of $500,000 for damages sustained due to discontinuation of the work by the contractor.

Has Free Garbage Collection and Disposal

Both garbage and dead animals are collected and disposed of by contractors at Springfield, Mo., without cost to the city. There are two separate contracts. Under one the garbage is fed to hogs. Under the other contract, which runs for a term of five years and is held by E. W. Biggs & Co., of Springfield, dead animals are treated in a reduction plant located about three miles from the city. This company has three trucks in service for the collection of dead animals in Springfield and vicinity. The collection service extends a distance of 40 miles. Dr. Edwin F. James is commissioner of health and sanitation. The contractor for the disposal and collection of garbage is J. C. Dysart.

Porous Canal Banks Blanketed by Hydraulic Sluicing

Temporary Power Line Supplied Current to Portable Plants—Material Spread From Flume on Raft to Leaking Area

THE Pishkun Canal, carrying 1000 sec.-ft. of clear water from the North Fork of the Sun River to irrigate 65,000 acres north of Fort Shaw, Mont., has been given a lining of silt supplied by hydraulic sluicing to check loss of water through the porous gravel in which the canal is excavated. This work was done by the engineers of the United States Reclamation Service.

Motor-driven pumps furnished the supply to hydraulic giants which washed fine material from the rocky slopes above the canal, as there was no adequate supply of silt fine enough to be carried in suspension for any long distance.

Furthermore, according to R. B. Stevens, superintendent of irrigation, in an article printed in the *Reclamation Record*, the limited waterway capacity at the lower end of the canal would have made it necessary to check the flow at various regulating structures in order to secure the desired depth of water.

In silting the first and most obstinate leak of 10 sec.-ft. in a depth of water of only 18 in. two centrifugal pumps were set up immediately above the leaking section, one a 2-in. pump direct connected to a 5-hp. motor, and the other a 4-in. pump belted to a 10-hp. motor. A 4-in. pipe line with nozzle was attached to the discharge of these pumps. The fine material among the rocks was washed out with the stream and run directly down the slope into the canal. This open-sluicing method proved unsuitable to the class of material handled, as all of it settled to the canal bottom before it had traveled more than 300 ft. A pit of finer material was then tried about 300 ft. from the canal. The same installation was used, but the material was carried to the canal through 16-in galvanized sheet-iron pipe. This pipe was used because available. It was laid on the ground and the material distributed across the canal by a flume supported on a raft, and having side openings at regular intervals. This method, although productive of somewhat better results than the first, was far from satisfactory, as the coarseness of the material caused it to sink within a short distance. Long-distance sluicing was then abandoned in favor of local work. The flume on the raft was extended to and along the canal bank with gate-controlled side openings toward the bank. With this arrangement it was possible to place a blanket of fairly impervious material on the sides or bottom to any desired depth, and by adjusting the height of the flume above canal grade and the depth of water in the canal, the blanket could be spread over nearly the entire inside slope of the bank and part of the bottom. This plan was quite satisfactory and was carried out until the loss in this 1600-ft. reach was reduced from 10 to 3.3 sec.-ft., while the depth of water in the canal was increased from 1.5 to 8 ft. When the depth of water was reduced to 3 ft., or double that when work first commenced, the loss was only 0.1 sec.-ft.

One of the worst leaks occurred in a 2000-ft. section below mile 1.3 in a stretch of coarse gravel overlying seamy shale. Part of the canal water seeped out through the gravel, but the greatest loss was through the shale in the canal bottom, the water appearing in springs along the river bank from 800 to 2000 ft. from the canal. At its maximum the loss was estimated at 35 sec.-ft. with a flow in the canal of 175 sec.-ft. Early in the season some material was hauled about 600 ft. in wheel scrapers from a pit to a sluicing plant placed near the upper slope of the canal, dumped through a trap into a chute, and sluiced directly into the canal. This method proved impracticable. Ground sluicing was used as before and the sluiced material from both pumps discharged into a common flume on a raft, with side openings distributing the material across the canal. Although the lower end of the leaking section was 3600 ft. down the canal from the plant, and the material was hard to get at owing to its location among rocks where it was necessary to use dynamite, when it was discharged into the canal the operation proved to be quite satisfactory. After 10 days' sluicing the surface leaks were reduced from 4.5 to 0.6 sec.-ft. with a marked reduction also in the underground losses. The plant was then closed down for the winter.

Alternating current for pumping was available at 16,500 volts on a transmission line built along the lower side of the canal. Current was obtained from the Great Falls Power Co. at a substation near the headworks at 1 to 2½c. per kw. hr. The ordinary force employed for each plant was a pumpman at $4 to $4.40 per day and two assistants at $3.30 to $3.60, dropping to one assistant when in good material which would not clog the flumes.

When the plant was moved the services of a man and team were required. For future operations it is planned to mount the plant on a raft and thus reduce the moving cost considerably.

The costs of this work were high owing to difficulty of securing the material in any large quantities, the cost of installing the electrical equipment for each move, and the high wages paid for labor. The cost of the sluiced material in place, exclusive of superintendence and general expense, was about 71c. per cu.yd., measured in excavation, of which 29c. was for power, plant, etc., and 42c. for labor and teams. About 2500 cu.ft. were excavated.

Leakage Is 5.85 Per Cent. of Pumpage

Water leakage measured on 108 miles of mains in Chicago in 1917 averaged 14,050 gal. per mile, which the report of the Department of Public Works states may be assumed as an average for the entire system of mains. On this basis the total leakage would be about 40,000,000 gal. per day, or 5.85% of the average daily pumpage. These figures are said to show that the leakage from mains is not as large an item of the total waste as is commonly supposed to be the case. The measurements were made on streets that were to be paved and were part of the investigations conducted by the engineer force of the water-pipe extension division, under the direction of John Ericson, city engineer.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Field Warehouse Record Card Carries Perpetual Stock Inventory

THE field warehouses which are maintained on each of the divisions of the Miami Valley flood protection work employ a card system for a stock ledger. Besides recording the warehouse transactions, these cards serve as a price list, a perpetual inventory of stock on hand, and a means of tracing material. The warehouse cards are printed on stiff paper and both sides are alike. A separate card is made for each size of each kind of supply or material passing the local warehouse. As indicated by the reproduction, space is provided for orders, receipts, issues and stock on hand. All the materials and supplies received on the division are handled through the local warehouse, and are obtained by orders on the general warehouse in Dayton. A record of these orders on the general warehouse is entered in the "orders" space. Goods are received on the division from the general warehouse, from direct shipments, or in a few cases from local purchases. Each shipment is accompanied by a way-bill carrying the unit costs and the values of the articles supplied. Entry is made of everything received, in the "receipts" space on the ledger card.

Duly authorized foremen carry books of "orders on local warehouse." When they desire material or supplies from the local warehouse they make out one of these orders, which shows also the item of work against which each article is to be charged. This charge is indicated by a number, in accordance with the standard account number system of the district, described in *Engineering News-Record* of Nov. 7, 1918, p. 865.

When the "order on local warehouse" is filled, the orders are posted in the space for "issues" on the record.

By carrying out the quantities and values in the "on hand" space, a perpetual inventory is had of the material on hand. No general inventory, with its attending confusion, is contemplated under this system. The man in charge of the local warehouse is expected, however, to check from time to time his material on hand with the balance on hand shown on the ledger card.

The accounting division audits the local warehouses from time to time, the local warehouse men never knowing when to expect such an audit. The accounting division has a record, obtained from the purchase records and the accounts of the general warehouse, of all of the material going into the local warehouse. This record is balanced against the total of the receipts at the local warehouse, and is also balanced, by both money and material, with the issues and the stock on hand. Test checks are made by the actual counting of some of the material that is on hand.

At intervals the local warehouse orders are sent to the accounting division at headquarters, where they become the original entry for the cost-distribution system, using the account number, as has been mentioned in a previous paragraph, to obtain the detail for the distribution.

The ledger cards remain in the field warehouses as a permanent part of their records.

This warehouse system was adapted from the one used by the United States Reclamation Service in keeping its records.

To All Contractors

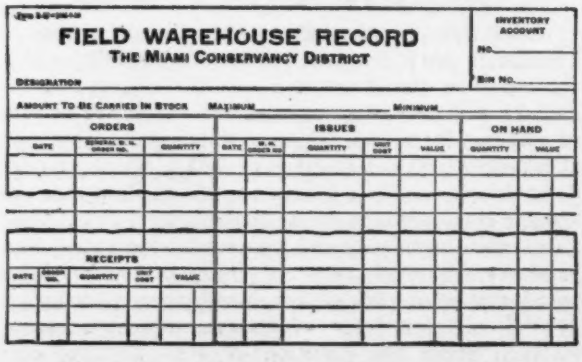
Read the Purposes of the Organizing Convention to be held in Chicago next week, on

Page 915

Then—

Read why it is needed and why you should attend, on

Page 879



FIELD WAREHOUSE RECORD
THE MIAMI CONSERVANCY DISTRICT

INVENTORY ACCOUNT
No.
BIN NO.

DESIGNATION

AMOUNT TO BE CARRIED IN STOCK MAXIMUM MINIMUM

ORDERS			ISSUES					ON HAND	
DATE	GENERAL W. H. ORDER NO.	QUANTITY	DATE	W. H. ORDER NO.	QUANTITY	UNIT COST	VALUE	QUANTITY	VALUE

RECEIPTS				
DATE	ORDER NO.	QUANTITY	UNIT COST	VALUE

WAREHOUSE CARD SHOWS STOCK ON HAND

Wheelbarrows Reduce Labor Force

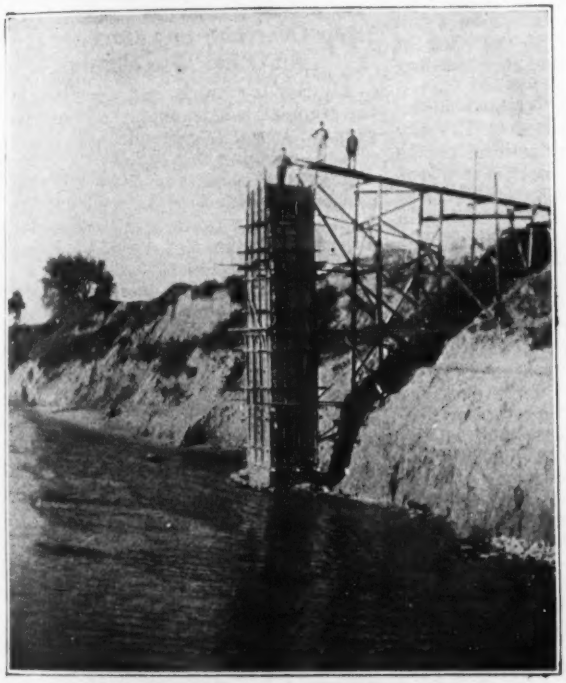
USE of wheelbarrows and inclined runways instead of hods and ladders, for delivering brick, mortar and concrete in building construction has materially reduced the labor force required for the construction of a new roundhouse at Galion, Ohio, for the Cleveland

Cincinnati, Chicago & St. Louis R.R. As the work is in open country, there is ample room for the approach incline, and the roof level is reached in two lifts or stages of inclines supported by the scaffolding. These runways are three planks wide, with hand rails on the longer incline from the ground level. The walls are of brick, with reinforced-concrete lintels over the wide window openings, in order to avoid the use of steel beams. The Walsh Construction Co., Davenport, Iowa, is the contractor, with John Lundstrum as superintendent.

Concrete Pier Built Vertical and Toppled Into Place

By G. H. Connolly
City Engineer's Office, Racine, Wis.

Built upward like a tower on the water edge, a 6 x 6 x 40-ft. concrete shaft was let topple into the lake to form a pier to protect a sewer outfall, at Racine, Wis. Wave action was gradually undermining the shore end of the submerged concrete outfall structure. Riprap was piled up against it at the shore, but every storm would wash the rocks out. It was decided to build a pier about 100 ft. south of the outfall, in the hope that this pier would protect the outfall and also change the wave action so as to form beach.



CONCRETE TOWER BUILT ON SHORE EDGE AND TIPPED INTO LAKE TO FORM PIER

To build a concrete pier out into the water would necessitate the construction of a tight cofferdam at a considerable expense and a great deal of inconvenience. City Engineer P. H. Connolly, therefore, decided to try the experiment of building a reinforced-concrete pier in an upright position on shore and then toppling it into the water.

The base, 6 ft. square, was built at the water's edge, the sand being excavated so that there was a clay foundation. This base was allowed to cure for about a week. A timber grillage was then built on the base and the sides were formed up. The plan was to burn the timber grillage out on the side toward the lake, allowing the pier to topple into the water. The pier was 6 ft. square and was built up to a height of 40 ft. in 6-ft. sections and reinforced with scrap iron. After a height of 20 ft. was reached the timber grillage began to crush and the pier leaned toward the lake. By the time the top was reached the pier was a foot out of plumb, but leaning in the right direction. After the forms were removed it was the intention to allow the concrete to cure for a couple of weeks before tipping it over, but the elements were against this plan. A heavy north-easter blew up, and during the night the pier toppled over into the lake. It landed in the right position and couldn't have been placed better if the placing had been done by man. In tipping, the pier must have slipped off the base, for a space of 6 ft. was left between the shore end and the base. One crack developed about the middle of the pier, but with such green concrete this was to be expected.

This pier has been a success beyond all expectation. In one month, beach has been formed out beyond the end of the pier, completely protecting the outfall and filling up the space between. The pier now looks like a slab on the sand. The cost of the entire construction was approximately $600. The work was done under the supervision of the Board of Public Works by day labor.

The estimated cost of a pier built in a cofferdam was $3000, so that the saving to the city was about $2400.

Concrete Delivered by Slip Scraper Pulled Along Wooden Trough

Operating in a shallow, wooden trough, a slip scraper conveyed concrete more than 100 ft. for making emergency repairs to a small dam under construction last fall. A break occurred in the headrace wall about 125 ft. from the spillway which was under construction at the time. Approximately 100 cu.yd. of concrete were needed for the repair work. The volume of work did not justify moving the concreting plant (consisting of a guy derrick and a stationary mixer) or the construction of an inclined chute to reach the whole distance. To move the concrete by hand would have been too expensive. As an alternative old lumber was utilized to build a trough about 3 ft. wide and 1 ft. deep along the level top of the headrace wall, one end at the break and the other at a point within the reach of the derrick. Beyond the break a snatch-block was anchored, and a rope was run from the river bank below through the block and back along the trough to the end by the derrick. A small slip scraper was attached to this end, and a horse was hitched to the end on the river bank. The concrete was dumped into the trough by the derrick, and moved to the break with the slip scraper. In this manner two men and a horse handled about 10 cu.yd. an hour. The work was done under the direction of E. P. Cartwright, civil engineer, Rochester, N. Y.

NEWS OF THE WEEK

New York, November 14, 1918

Sweeping Changes in Priority Regulations Aim to Assist Reconstruction

War Industries Board Adopts Measures for Construction To Resume on Peace Basis Quickly as Possible

Far-reaching changes in priority regulations were announced Nov. 12 by the priority division of the War Industries Board, through the issuance of circular No. 57. The regulations are drawn with a view to insuring the most expeditious return of industry to a peace-time footing.

Section 1 of the circular revises section 5 of the last priority circular, dealing with non-war construction, by making 12 reclassifications of construction work so that projects falling within the reclassification will be automatically approved by the new circular, and it will not be necessary to obtain permits or licenses for them from the non-war construction section of the Priorities Committee. The reclassification is as follows:

1. Construction projects approved in writing by the facilities division of the War Industries Board.

2. All farm and ranch buildings, structures or improvements.

3. All buildings, structures, roadways, plant facilities, or other construction projects of every nature whatsoever, undertaken by the United States Railroad Administration, or by any rail or water transportation company, organization or utility (whether or not under the direction of such administration) or by the American Railway Express Co., or by the owner or operator of any telegraph or telephone line.

4. The construction, maintenance, improvement or development, by Federal, state or municipal authorities, of highways, roads, boulevards, bridges, streets, parks and playgrounds.

5. The construction, extension, improvement, maintenance or repair of any public utility, including water-supply systems, sewer systems, light and power facilities, and street and interurban railways.

6. The construction, extension or repairs of all irrigation and drainage projects.

7. Construction projects connected with the extension, expansion or development of mines of every character whatsoever, or connected with the production and refining of mineral oils and of natural gas.

8. The construction, alterations or extensions of, or repairs or additions to, plants engaged principally in producing, milling, refining, preserving, refrigerating or storing foods and feeds.

9. The construction of new, or the alterations or extensions of existing, schoolhouses, churches, hospitals, and Federal, state or municipal buildings, involving in the aggregate a cost not exceeding $25,000.

10. The construction of new buildings or structures not embraced in any of the foregoing classifications, or the repairs or additions to, or alterations or extensions of, existing buildings and structures, in either case involving in the aggregate a cost not exceeding $10,000.

11. The construction of new buildings or structures not embraced in any of the foregoing classifications, or the repairs or additions to, or alterations or extensions of, existing buildings or structures, in either case involving in the aggregate a cost not exceeding $25,000; when approved in writing by the state Council of Defense or its duly authorized representative.

12. Buildings begun prior to Sept. 3, 1918, where a substantial portion of the building has already been constructed.

The second section of the circular states that all limitations on the production of building materials, including brick, cement, lime, hollow tile and lumber, are hereby removed, and the materials so produced may be sold and delivered for use in connection with any building project for which no permit or license is required under the 12 classifications of section 1.

Section 3 cuts in half the restrictions on the consumption of materials in the production of a wide list of commodities. Where an industry has been curtailed a certain percentage in production or in the consumption of materials for a stated period, this percentage has been reduced one-half; as in the case of an industry that has been curtailed 25% for the last four months of 1918, such curtailment is reduced by the circular to 12½%. The list of commodities mentioned includes road machinery, farm tractors and builders' hardware.

Section 4 relieves dealers in raw materials, semi-finished and finished products from the obligation to give and require any pledges relating to such commodities enumerated in any of the orders or circulars issued by the Priorities Division, or any previous stipu-

(Concluded on page 917)

No More Army Commissions

Secretary of War Baker announced Nov. 12 that there would be no further recruiting for officers in the Army. Except for the regular promotions in the service and for the rare cases where some specialist position is to be filled, no more officers will be commissioned. All campaigns for candidates for commissions in the engineer and other staff corps have been stopped.

Drop Overtime in Shipyards and All Other War Plants

All Sunday work and overtime in Government construction, and in Government-owned or controlled plants and plants producing war supplies, are to be discontinued, according to instructions which it was decided to send out immediately, at a conference between the Secretary of the Navy, the Chairman of the Shipping Board, and the Secretary of War, Monday morning following the announcement of the armistice.

The readjustment of the labor and industry of the country will be undertaken, with a view to bringing it about with the least dislocation of labor and the greatest facility possible to be afforded for the reëstablishment of industry, according to plans of the War Industry Board and the Department of Labor.

Illinois Voters Approve Bond Issue for Highways

Approval was recorded by a large majority of the voters of Illinois for the $60,000,000 bond issue for highways, at the recent election. This large system of highways can now go forward as soon as the bonds are sold.

The election was held on the basis that the roads would not be built until after the war. However, surveys are to begin at once, so that the Highway Department can be ready for construction when the funds are available. The system consists of 4800 miles of connecting highways. A description and map showing the location of the various highways were published in *Engineering News-Record* of Oct. 24, p. 777.

Aside from the $60,000,000 bond issue for state roads, the City of Chicago voted $3,000,000 to complete the Michigan Boulevard link improvement. This much-needed connection can now be made.

Chicago Road Meeting Postponed One Week

The joint convention of the American Association of State Highway Officials and the Highway Industries Association has been postponed from Dec. 2-6 to Dec. 9-13. The meeting will take place in Chicago.

Tacoma Votes for Port District

At the election Nov. 5 the County of Pierce, in which Tacoma, Wash., is situated, voted by a large majority in favor of the establishment of a port district which, under the state law, will have authority to study the local problems and devise a general scheme for the development of the port of Tacoma. The large favorable vote was due to recognition of the fact that trans-Pacific trade will become a great factor on the Pacific coast after the conclusion of peace. The district includes the entire county and will be under the management of three elected commissioners who will serve without salary. The state law permits such a district to raise funds by an annual tax not exceeding two mills on the dollar of taxable property in the county. Until a definite plan has been prepared by the commissioners and adopted by public vote, no money can be expended beyond that necessary for the presentation of the plans. Thereafter only the amount raised by the tax can be expended until the people by a 60 per cent vote have authorized the issue of bonds. These bonds are limited to 3% and may be for a term of 50 years.

Highway Bond Issue Approved by 180,000 in Pennsylvania

Pennsylvania has reversed its 1913 attitude on highway construction, by approving a constitutional amendment providing for the issuance of $50,000,000 worth of road bonds. The majority for the amendment was approximately 180,000, a turnover in good roads sentiment since 1913, when the issue lost by 40,000, of 220,000 votes. Only three counties voted adversely.

Like the program in Illinois, mentioned elsewhere in this issue, the Pennsylvania program called for delay in issuing the bonds until after the war. Since the war is now over, work can go forward without delay, providing the state legislature immediately enacts the laws to make it effective.

Contract Signed for Laguna Dam Connection

The contract for the Laguna dam connection, a part of the project for an all-American canal to serve the Imperial Irrigation District, California, has been signed by Secretary Lane on behalf of the United States Government. It had been previously signed by the officials of the district, as stated in *Engineering News-Record* of Oct. 17, p. 724, but will not become effective until approved by the voters of the district, at an election tentatively set for Dec. 21.

Stabilizing of Entire Contracting Field Is Purpose of Chicago Meeting

Contractors Will Organize in Convention Next Week To Establish Standards of Practice

To stabilize the general contracting business, and to create better relations between the contractor, the engineer and the owner, is the aim of the meeting to be held in Chicago Nov. 20-21. The contractors will convene at that time to perfect the organization of the National Association of General Contractors, 4000 invitations to join which have been sent to reputable firms and individuals throughout the country. It is reported that more than 1000 acceptances have been received, and that the Secretary of War has expressed his willingness to speak if his engagements will possibly permit to do so.

The organization had its inception at the formation of the National Federation of Building Industries in Atlantic City July 15-16. At that time the contractors realized that the field of the federation was so wide and large, and the interests of the general contractor had become so involved, that more specific attention, which could be realized only through a general contractors' association, was absolutely necessary.

Although the perfecting of the organization is the chief business of the convention, one of the main objects of its formation will be to promote efficiency and higher standards of business and ethics. As stated by the committee appointed in July, the object of the association is threefold: First, confidence between the contractor and the owner; second, confidence between the contractor and the material man, and third, confidence between the contractor and labor. It is pointed out that the nature of these objects makes it necessary to confine the membership of the organization to contractors or contracting firms engaged in construction work which undertake and carry out, at least partly with their own forces, construction operations of any description in their entirety.

Those Ineligible for Membership

Some misunderstanding has arisen over the clause in which the matter of friends or associations ineligible for membership is treated. It is not the intention of the association to antagonize or in any manner eliminate the good feeling that exists between general contractors, in the sense under which they are organizing, and contractors who either supply materials or do the work only partially under subcontracts. On the contrary, the association is formed to make possible a coördination of activities such that the dealings between the general contractor and these other activities will be carried on more efficiently and broadly.

The committee points out that confidence between the general contractor and the engineers and the owners is of paramount importance under the existing conditions. The feeling of suspicion that exists in the minds of owners when dealing with contractors is admitted to be the result of the stigma brought upon the contractors through the practices of unreliable men whose desires to increase their profits overpowered their inclinations toward honesty. One of the efforts of the association will be to eliminate this element, and by a systematic campaign of education to reëstablish the confidence necessary for success of any project.

Relations With Material Men

In the relations of the contractors with the material men, it is pointed out, the organization will not exclude any company or association that sells construction material, providing it is also in the general contracting business. For instance, the American Bridge Co. is a steel merchant, but it is also a general contractor in that it will take a contract to construct a building or bridge in its entirety. All the members of the Bridge Builders' and Structural Society have been invited to join, as well as any other material-producing firm that does actual contracting work. The objects of the association make it necessary for the general contractor to have controlling representation, so that his interests will receive paramount attention. This, it was pointed out, was not possible in an organization such as the Federation of Building Industries formed last summer, in which the smaller or subcontractors as well as the host of material men outnumbered the general contractors to such an extent that it would have been impossible for them to give the general contractors' problems the attention they require.

The committee also calls attention to the situation as to the problem of labor, and shows that it is assuming such proportions that will require most careful consideration. It is the intention of the association to handle this subject on a broad and equitable basis, on the ground that labor is also entitled to all the money it can make and it is the committee's opinion that unless the problem is handled in this light only delay, trouble and possible disaster will result. The committee asserts that the time is past when any large association can, by the weight of its members or influence, control labor in a manner inimical to the workers' interest.

The number of replies and acceptances to the invitations sent out has exceeded all expectations. From these replies the committee predicts the convention will be one of the most important meetings of its kind ever held.

Brigadier General Marshall of the construction division of the Army has

been invited, and has commended the aims as set forth in the invitation, stating that he will attend if possible. Charles M. Schwab of the Emergency Fleet Corporation has also expressed his endorsement of the purposes of the convention. Col. W. A. Starrett has stated that an association of this kind, with representatives at Washington, is so important, in his estimation, that should a Washington representative be appointed he will see to it personally that it is immediately supplied with offices and equipment.

Nominations for New England Water-Works Association

The nominating committee of the New England Water-Works Association has made nominations for officers of the association for the year 1919, including the following: President, Samuel E. Killam, superintendent of pipe lines and reservoirs, Metropolitan water-works, Boston; secretary, Willard Kent, civil engineer, Narragansett Pier, R. I.; editor, Henry A. Symonds, consulting engineer, Boston; and treasurer, Lewis M. Bancroft, superintendent of water-works, Reading, Mass.

Pooling of Government Motor-Vehicle Equipment Successful

The pooling, recently ordered, of the motor-vehicle equipment of the Army under the control of the Motor Transport Corps, has proved so successful in the District of Columbia, where it was first tried, that the system will speedily be extended to the entire United States. All passenger and cargo-carrying vehicles are included in the order, the effect of which will be to give a more efficient motor-transportation service for the Army with a greatly reduced equipment. Heretofore, motor vehicles have been assigned to the various departments for their exclusive use. Under the new plan, they will be operated under one control and for the benefit of all departments.

In Washington, where the need for passenger cars for official business is great, an elaborate taxi system has been established, consisting of 13 stations connected with an adequate system of telephones. Officers above the rank of captain are provided with cards entitling them to call Government cars, when needed, for official business only. Junior officers and civil-service employees must have trip tickets to gain the use of the special motor-car service. A bus service, operated on schedule between the principal buildings occupied by Army organizations, provides transport over regular routes for officers and employees on official business.

These arrangements have made it possible to reduce to 23 the large number of motor cars formerly assigned to officers for their individual use. Only the heads of departments, corps and bureaus are entitled to have cars assigned to them individually. The new system will reduce the motor equipment necessary for the Army's use.

Discuss Snow Removal and Highway Transport

Highway Traffic Association of State of New York Considers Plans for the Coming Winter

Snow removal in its various aspects and difficulties, and in its relation to highway transportation projects such as mail and industrial deliveries, was discussed at the meeting of the Highway Traffic Association of New York State, held Nov. 11 in New York City. Many prominent speakers who are experienced in snow removal were present and gave information as to cost, methods and necessary equipment. Throughout the meeting a patriotic sentiment prevailed, and many of the speakers prefaced their remarks by calling attention to the importance of highway improvements in giving employment to the returning soldiers. The president of the association, Prof. Arthur H. Blanchard, presided, and presented a resolution adopted by the executive committee favoring snow removal from the motor-truck routes by the various states.

Success of Motor Parcel Post

In announcing the success of the motor parcel-post service and the importance of good roads every day in the year, James I. Blakeslee, fourth assistant postmaster general, called attention to the use that might be made of the thousands of motor trucks being employed by the present military establishment. He stated that there are about 100,000 of these either in service or in course of construction, and suggested that they might be used in Government transportation of mail and merchandise.

The financing of a great system of national highways to take care of this service could be handled with much less friction than by the taxing method on account of the fact that the revenues of the service would soon pay the entire cost, it was asserted. As evidence of this fact, Mr. Blakeslee said that with a present investment of $300,000 the earnings of the service are $2,000,000 per year.

Snow-removal methods and equipment were next taken up, the principal speakers being Charles J. Bennett, state highway commissioner of Connecticut, and George H. Biles, second deputy highway commissioner of Pennsylvania. Attention was called to the various methods which must be used in various localities, depending upon the amount and character of the traffic. An important thing, according to Mr. Bennett, is to start early in the storm and to have the equipment so located, so manned and so instructed that upon the occurrence of a 3-in. fall of snow the organization will get to work without orders by telephone or otherwise.

Motor trucks with plows and road machines are used in snow removal, and rollers are used where it is desired to preserve the sleighing. Both speakers mentioned the value of the Weather Bureau reports in reporting the approach of storms.

Mr. Biles outlined the experience of Pennsylvania in snow removal during the past winter and called particular attention to the economic side of the matter. He asserted that, while at first the officials had considered the expenditure as practically a waste of money, they are now convinced that it is of great value in preserving the roads, the state roads having come through last winter in much better condition than ever before. On improved roads it is important to clear the snow to a maximum depth of 3 in., so that it will quickly melt and not rut; the rutting causes the motor trucks to follow the same track and thereby injures the surfacing. Open drainage is also an important factor. For a fall of 12 in. of snow, road machines work the best. From 12-in. to 36-in. trucks, with plows, are preferred. For a depth of more than 3 ft. a large A-shaped plow, with a spread of 16 ft. at the back, has proved successful. Snow removal costs from $50 to $200 per mile, according to conditions. Snow fences built for about 50c. per running foot have proved useful as a preventive.

Conditions in New York State were discussed by H. E. Breed, first deputy commissioner of highways, who read a letter from Commissioner Duffey, and by the Hon. Peter J. Ten Eyck, regional chairman, second district, Highways Transport Committee. While New York got a bad start last year in snow removal by waiting until the roads had a covering of from 1 to 2 ft., full preparations are being made to keep the main truck routes open in the coming winter. The importance of selecting the roads to be cleaned, so that the present transportation facilities are utilized to the utmost, and of coöperation with the local authorities to this end, was brought out by Mr. Duffey. Mr. Ten Eyck bore particularly on the danger of cleaning roads to such an extent that sleighs could not be used for transportation.

Work of Transport Committee Described

A short description of the work of the Highways Transport Committee was given by Raymond Beck, field engineer for the committee. He emphasized the fact that this committee would have as much work in the reconstruction period as it had during the war, if not more, and stated that the personnel of the committee now consists of 30,000 men. Col. W. D. Sohier, chairman of the Massachusetts Highway Commission, spoke briefly upon snow removal and the economics of highway transportation. He does not believe that motor-truck transportation will expand to any great extent, because railroad equipment can carry freight for one-tenth the cost and much faster. If highway transport is to be developed, roads that are tremendously stronger than those we now have must be built, according to Colonel Sohier, and others.

Sweeping Changes in Priority Regulations

(Concluded from page 914)

lations that required pledges from those why buy them for resale; except for such work as is not included in the 12 classifications.

In conclusion, the circular states that the Priorities Division will, as far as practicable, assist industries in procuring materials, fuel, transportation and labor to enable them to increase their operations to normal limits as rapidly as conditions may warrant. Precedence must, however, be given to stimulate and increase the production of cargo ships and supply the requirements of the Army and Navy of the United States, as well as to provide for this nation's share of the enormous volume of materials, equipment and supplies required for the reconstruction of the devastated territories of Europe. Precedence will also be given to such activities as will tend to stimulate the production of coal, natural gas, oil and its products, and of minerals; and to provide for maintenance, additions, betterments and extensions of railroads, telegraph and telephone lines, and other public utilities, and to permit and stimulate the intensive development of inland waterways.

Akron Adopts Commission-Manager Form of Government

Akron, Ohio, adopted a commission-manager form of government by the vote Nov. 5 on a proposed new charter for the city, for which 11,584 votes were cast in favor, and 6233 against. In the main, the new charter calls for a form of government formally known as the commission-manager form, although in Akron the commission will be called the council and the manager will be known as the chief administrator.

The council will consist of nine members, including the mayor, who will be elected by the people and will act as presiding officer of the council. The other members of the council are elected at large for four-year terms, four members being elected every two years. The mayor is to be elected for a two-year term. The council is subject to recall.

Under the terms of the charter adopted the chief administrator will be chosen by the council and can be removed by that body. He will select the department heads, with the exception of the director of the department of public health, who will be appointed by the health commission, the members of which will be selected by the chief administrator. The other departments created by the charter are those of law, public service, public safety, social service, and finance. The chief administrator also appoints members of the civil commission.

The charter gives broad powers to the city planning commission, appointed by the mayor.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 9-13, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

The National Federation of Building Industries will hold a meeting at Atlantic City Dec. 7, immediately following the meeting of the war service committees under the auspices of the Chamber of Commerce of the United States.

The New England Water-Works Association held its November meeting in Boston yesterday. After a meeting of the executive committee in the morning, a general meeting was held in the afternoon, the chief topic of discussion being "Experience on Labor Troubles." Papers were delivered on "Rates of Flow in Service Pipes and Meters," by Caleb M. Saville, Board of Water Commissioners, Hartford, Conn., and "Painting Standpipes," by Charles W. Sherman, consulting engineer, Boston.

The Brooklyn Engineers' Club will hold its regular meeting for November tonight, and will be addressed by George A. Orrok, New York, on "The Hydro-Electric Installation on the West Canada Creek at Trenton Falls, Near Utica, N. Y." A description of the plant that is the subject of Mr. Orrok's lecture was published in *Engineering News-Record* of May 30, 1918, p. 1028.

The Washington State Good Roads Association will hold its annual meeting at Pasco, Nov. 21-22. It is said that a large part of the discussion will be devoted to a state-wide system of highways. R. K. T. Hany, U. S. engineer, Yakima, Wash., will speak on "Preparation for Peace."

The Engineers' Club of Philadelphia will be addressed by George S. Webster, director of the Department of Wharves, Docks and Ferries of Philadelphia, on "The Port of Philadelphia," at the weekly luncheon to be held Tuesday, Nov. 19.

The Louisiana Engineering Society will be addressed at its meeting Nov. 18 by Leo. S. Weil, who will speak on "Fuel Conservation in Louisiana." It was necessary to postpone the regular meeting of the society from Nov. 11 to Nov. 18 on account of the influenza epidemic.

PERSONAL NOTES

LEWIS C. DUNCAN, Westville, N. J., has been appointed a member of the New Jersey State Highway Commission, succeeding the late George W. F. Gaunt.

WALTER MCNICHOL, Scranton, Penn., has been appointed chief of the Bureau of Factory Inspection and ex-officio acting Commissioner of Labor and Industry, succeeding Col. John Price Jackson, now absent on military duty.

R. E. KREMERS, chief of the bureau of construction, Board of Public Works, Portland Ore., has been commissioned with the rank of captain and assigned to duty with the 403d Engineers, stationed at Fort Douglas, Utah.

LIEUT. COL. PHILIP SCHUYLER DOANE, head of the health and sanitation division, industrial relations groups, United States Shipping Board, Emergency Fleet Corporation, will go to France during the next month to engage in hospital work.

CHARLES DAVIS, Spokane, Wash., has been appointed acting city engineer of that city during the absence of A. D. Butler, who has entered the construction division of the Army, as mentioned in *Engineering News-Record* of Oct. 17, p. 736.

JOHN F. LABOON, who was previously with the Pittsburgh Filter Manufacturing Co., Pittsburgh, Penn., has become a member of the firm of Chester & Fleming, engineers, Pittsburgh, by which he had formerly been employed.

D. G. THOMAS, chief engineer of the Denver Union Water Co. for the past 15 years, has resigned to enter private practice as a consulting engineer. During the first half of his 30 years' service with the company and its predecessor, he was general superintendent, his earlier experience in public utilities having been gained in England in gas works. The plant of the Denver Union Water Co. was turned over to the water commissioners of the city for operation, but the company still retains its corporate identity, the change in administration being brought about by the recent popular vote mentioned in these pages.

H. M. NABSTEDT, assistant engineer for the new water supply of Oklahoma City, has been appointed chief engineer, succeeding Guy V. McClure, whose death is noted elsewhere in this issue.

E. K. TROIL, C. L. Wartelle and R. W. McCrory, of the city engineering department of Seattle, have been com-

missioned in the Corps of Engineers, each with the rank of first lieutenant.

A. H. KINDRICK, city engineer of McAlester, Okla., has resigned to become supervising engineer on the construction of the sewage-disposal plant at Okmulgee, Okla., for Burns & McDonnell, consulting engineers, Kansas City, Mo.

HENRY R. STEVENS and Robert L. Rockwell have announced the dissolution of the firm of Stevens & Rockwell, consulting engineers, Seattle. Mr. Stevens has become electrical engineer for Stone & Webster's Seattle division, and Mr. Rockwell will continue in private practice, taking over the organization and equipment of the firm.

EDWARD EVERTT HALL, inspector, city engineering department, Seattle, has been commissioned in the Corps of Engineers with the rank of captain.

WALTER C. PATON, city engineer of Excelsior Springs, Mo., has been commissioned as a captain and assigned to the 412th Engineers, Camp Sherman, Ohio.

F. J. BISAILLON, K. C., Montreal, has been appointed as a member of the International Waterways Commission, succeeding P. B. Mignault, who has been appointed judge of the supreme court.

LIEUT. HARVEY C. C. WALKEM, Canada, who was severely wounded in France, winning the Military Cross, has been appointed resident engineer, Petewawa Camp, Ontario. Lieutenant Walkem is a graduate of the Royal Military College, Kingston.

CALVIN E. COCK, Spur, Tex., has been appointed engineer for the $3,000,000 road bond issue in Baylor County, Texas.

H. H. BIGHOUSE, second vice-president and chief engineer, C. O. Bartlett & Snow Co., Cleveland, who has been in charge of the eastern district of the company, will hereafter have his headquarters in the main office of the company at Cleveland, after the closing of the eastern branch in New York City on Nov. 12.

W. A. WYNN, Harrisburg, Penn., has resigned as engineer of the bureau of township highways, Pennsylvania State Highway Department, to become engineer for an organization of oil companies engaged in the development of Texas oil fields.

MAJ. GEORGE A. JOHNSON, officer in charge of the water and sewer section of the maintenance and repair division of the Construction Division of the Army, previously a consulting engineer of New York City, has been promoted to the rank of lieutenant-colonel, becoming ranking officer under Col. C. D. Hartman, officer in charge of the Maintenance and Repair Division. Some months ago Major Johnson closed his office in New York City and since then has been devoting his entire time to Government service.

F. L. SANFORD, lumberman and lumber mill owner of Zona, La., who recently has been largely engaged in advising Government departments on lumber purchases, has been commissioned with the rank of captain in the 20th Engineers, one of the forestry regiments.

H. L. TREEMAN, industrial engineer, J. G. White Management Corporation, New York City, has been promoted to the position of manager of the electric department of the Eastern Pennsylvania Railways Co. and the Eastern Pennsylvania Light, Heat & Power Co. of Pottsville, Penn., both of which are operated by the White corporation.

ROBERT C. BARNETT, until recently of the Missouri State Highway Department, has become economic engineer for the highways transport committee of the Missouri Council of Defense at Jefferson City, Mo.

BURTON LOWTHER, acting chief engineer of the Denver Union Water Co., has been made chief engineer of the water-works, which were turned over by the company to the water commissioners Nov. 1. Mr. Lowther went to Denver three months ago from Kansas City, where he had been chief engineer of the water department. He succeeds D. J. Thomas, mentioned elsewhere in these columns.

OBITUARY

EARL MILLER, Berkeley Springs, W. Va., for several years county engineer of Morgan County and district engineer of Berkeley, Morgan and Jefferson Counties, died recently, at the age of 28.

M. A. BENBENNICK, Bremerton, Wash., vice-president of the Northwest Master Builders' Association, died Oct. 18. Mr. Benbennick was also president of the Building Industries Board of Kitsap County, and had been active in the formation of the association.

I. M. BROWN, engineer maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis Ry., at Indianapolis, Ind., died Oct. 3. He was born at Waynesboro, Penn., Feb. 3, 1882. His service with the railway began in 1907, as an instrumentman. He was successively inspector, supervisor of track, assistant engineer maintenance of way on the Chicago and Cincinnati divisions, and then engineer maintenance of way of the Indianapolis Terminal division.

GUY VINCENT MCCLURE, chief engineer for the new water supply of Oklahoma City, died Oct. 23 at the age of 43. After two years in general surveying work, Mr. McClure entered the service of the Sapulpa & Oklahoma Western Ry. in 1895, and remained in railway work until 1906, when he resigned as chief engineer of the Oklahoma City, Lexington & Sulphur Springs Electric Ry. to engage in private practice in the firm of Moore & McClure, consulting engineers of Oklahoma City. He was city engineer of Oklahoma City from 1911 to 1917.

MAJ. HAROLD W. ESTEY, who went to France in September, 1917, with the 101st United States Engineers, died of pneumonia Oct. 28. He was detailed from his regiment to a French staff war college, and after completing the course was assigned to duty as liaison officer connected with the General Staff. In April of this year he was decorated by the French Government for bravery. His military service began in 1897, as a private in the former First Corps of Cadets of Boston, in which organization he was a captain when war was declared. Soon after he became a major in the 101st United States Engineers. He was 46 years old.

CHARLES JOHN AUGUSTUS MORRIS of the firm of Morris, Shepard & Dougherty, railroad contractors in St. Paul, died in that city Oct. 27 at the age of 68. Mr. Morris was the chief engineer of the old St. Paul & Duluth Ry., now part of the Northern Pacific, from May, 1898, to 1900, when it was taken over by the Northern Pacific. After a short time in the service of Frankman Bros., bridge contractors, he formed the firm of McMullen & Morris in 1892. Mr. Morris' first engineering work was on the location and construction of the St. P. & P. R.R., from Barnesville to St. Vincent in 1871, and the construction of the railroad bridge over the Mississippi River at St. Cloud in the same year. In 1876 he became assistant engineer with the United States Engineering Department on surveys of the smaller lakes in Minnesota.

HOWARD RAYMOND MOORE, Company 3, Engineer Officers' Training School, Camp A. A. Humphreys, Virginia, died of pneumonia Oct. 3. He was graduated from the College of Civil Engineering at Cornell University in 1913 and was afterward on subway construction work in New York City and on power-house construction work at Omaha, Neb. He withdrew from the latter in 1917 to enter the Signal Corps of the Army on the construction of aviation fields at Fort Worth, Tex., and later at Lonoke, Arkansas.

FIRST LIEUT. HUNTER MCCLURE, Co. N, 21st Engineers, died of disease in France Sept. 26. Lieutenant McClure was a graduate of Cornell University, and at the time of his enlistment in December, 1917, was in charge of a field party on the valuation work of the Interstate Commerce Commission in California.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Scientific Precision for Industries Advocated

Present and Future Conditions Indicate Necessity for Study of Reduced Waste

War-taught lessons of scientific precision applied to all industrial operations is the substance of an article in a recent issue of *Commerce Reports* by Burwell S. Cutler, chief of the Bureau of Foreign and Domestic Commerce. He contends that the elimination of waste in distribution as well as in production, and the close study of the laws of supply and demand, are basic necessities. He says:

"If there is any one thing that the present war has taught our producers and merchants it is the basic necessity of scientific precision. Time and again military failure has been threatened by inability to utilize to the *n*th degree the scanty materials available for production of munitions. This is no less true in the manufacture and distribution of uniforms than of guns and shells. The elimination of waste, whether it be in men or time or material, has been forced upon all belligerent peoples as a measure of national defence.

DIFFICULT CONDITIONS MET

"It was impossible for any one of the belligerent nations to increase its production proportionately to the needs of its armies and its civilian population and at the same time withdraw from factory and shop millions of men—unless the utmost skill in the use of remaining facilities was employed. Factory after factory had to reduce the waste formerly resulting from rejection of faulty workmanship; even the original amounts of material allowed for standard units of production were reduced to the point where greater output and less material ran concurrently. For instance, a far greater volume of steel products is now being made with less steel than was anywhere near the case four years ago. Less wool is found in clothing; less first-grade sole leather in shoes, etc. Yet this change has come about in many cases without deterioration in quality, measured by the usefulness of the article. It is quite conceivable that a 6-in. shell can be given as high a destructive force with a $\frac{1}{8}$-in. casing as a $\frac{1}{4}$-in. casing, and that is true of the other commodities mentioned, the test being always the exact purpose to be served.

"Under the supervision of the best scientific managers to be found in industrial and mercantile life, every process of production and distribution has been carefully measured, until a nearly ideal attainment is established as a standard for all to follow. The need was desperate and the regeneration has been thorough.

"It may be said that the ground of procedure has been exact data, ascertained by thorough study and experimentation. Putting it another way, no goods are manufactured for which there is not a specific need thoroughly apparent and demandatory; neither is there delivery of articles to any region or people where want of them is not acute. This surety of procedure requires, of course, a prior study of the facts, and these facts are the data to which I refer. The inquiry has extended into many phases of human activity.

"This habit of basing all operations on sound and accurate information may be expected to survive after the war in the factories and storehouses of Europe. We in the United States must adopt the same attitude of scientific precision and should, as business men, avoid the excess cost of business conducted on inspiration as compared with business based on industrial and trade data. The Department of Commerce and other institutions of Federal, state and private authority can supply our business interests with the facts of the case relative to almost any economic problem or uncertainty, if the business men will acquire the habit of applying to those agencies for advice and information."

Wider Use of Metric System in This Country After War

That there will be a wider use of the metric system in this country after the war is indicated in the adoption of a resolution regarding the matter by the American Section of the International High Commission. The resolution recommends more extensive use of the metric system in the trade and commerce of this country. The commission regards this subject as of particular importance to the United States, pointing out that one of the main obstacles to documentary uniformity between the United States and Latin America is to be found in the fact that the United States does not make the use of the metric system obligatory.

Now that the United States is being drawn into closer and more vital commercial relations with the rest of the world, and particularly with Latin America, it is pointed out that our manufacturers and exporters will be obliged to meet the demands of their prospective customers, and the use of the metric system, it is pointed out will be an important step in that direction.

Program of Industrial Conference Announced

War Emergency and Reconstruction Meeting Will Concentrate on Post-War Conditions

Announcement has been made of the program of the Nation's Industries War Emergency and Reconstruction Conference, to be held in Atlantic City, Dec. 4-6. The meeting will be held as stated but, since the war is ended, the original plans for a war emergency conference will be diverted, so the whole conference will be concentrated on reconstruction.

One of the main purposes of the convention, as indicated in previous announcements, will be the forming of a federation of all the war service committees under the direction of the Chamber of Commerce of the United States. The 354 war service committees which until now have been acting separately will have means for concerted action through the federation.

The program announces that on Dec. 4 the opening session will be held on the "million-dollar pier," at 10 a. m. It will be followed by the general session at 2:30 p. m., in the same place. The separate meetings of the 350 or more war service committees will be held in the evening, and anyone who will attend is directed to consult the chairman of his committee to learn the place of meeting.

On Dec. 5, at 10 a. m., another general session will be held on the same pier; to be followed at 2:30 p. m. by the conferences of the ten major groups of committees. This will probably consume the remaining time of that day.

Another general session will take place on the same pier at 10 a. m. Dec. 6, and the final session at 2:30 p. m. in the same place will close the conference.

First Woman To Take Up Electric Welding Now at Hog Island

Miss Sarah A. Erwin, electric welder, is the first woman in the United States to be engaged in actual ship construction work, according to information received from the United States Shipping Board. Miss Erwin says that she likes the work and enjoys the distinction of being the first woman actually to have a hand in building the ships which will carry supplies to France.

She is the only woman in the correction and angle-plate shop of the Hog Island shipyard.

Miss Erwin is a product of the electric welding class of the yard training school, established under the direction

of H. A. Horner, head of the welding branch, industrial relations group, United States Shipping Board, Emergency Fleet Corporation. Miss Erwin spent two weeks in the school. Miss Anna Kanvisto took the same course and is also doing construction work.

Board Established to Adjust Government Contracts

Appointed by the Secretary of War to Hear and Determine Claims, Doubts or Disputes

A Board of Contract Adjustments has been constituted by order of the Secretary of War, to hear and determine all claims, doubts, or disputes which may arise under any contract made with the War Department.

Through the operation of the board, the contractors supplying the Army will be able to submit to it any differences that may arise between them and the contracting officers of the various supply bureaus. It will act without any of the technicalities of court procedure and insure a speedy and equitable adjustment, according to the bulletin sent out by the War Department. The board says that the service of lawyers will not be necessary, as the contractor or his representative may appear before the board and state his case clearly and fully, with the assurance that he will receive an impartial hearing and a prompt decision.

The members who have been appointed are Lieut. Col. Christopher B. Garnett, chairman, who was formerly chairman of the Corporation Commission of Virginia; Lieut. Col. H. H. Lehman, chief of the methods section, purchase branch, purchase, storage, and traffic division; and Lieut. Col. Edward S. Malone, formerly assistant corporation counsel of New York City for the Borough of Queens. The legal advisor of the board will be a judge advocate appointed by the judge advocate general. The board will also have a recorder and several examiners, who will be commissioned officers of the United States Army appointed by proper authority. The office of the Board of Contract Adjustment will be in Washington, but it is stated, hearings may be held in such other places as may be found convenient or necessary for the proper performance of its duties.

County Purchasing Motor-Propelled Road Equipment

The Mercer County (N. J.) Board of Freeholders has adopted a plan to obtain a number of motor-propelled snowplows to keep the highways open during the winter. They will confer with the committee on transportation of the Council of National Defense, and coöperate with the committee in working on the problems of keeping the roads throughout the East in the best possible condition, made necessary by the heavy war traffic.

Adjustment of Industries to Peace Basis

At Present War Contracts Will Largely Continue, but Cancellation Is Provided For

The cessation of hostilities has brought to the front the question of the adjustment of industries from war to a peace-time basis. For some time, for a period to be determined by the war-making agencies of the Government, Government contracts must continue on a wide scale, says a statement issued by Mr. Baruch of the War Industries Board. A memorandum issued by General Goethals, chief of purchase, storage and traffic, in the form of a circular provides for the cancellation and termination of contracts on which the work has not been finished.

The circular states that the contract provisions have been worked out with considerable care to meet the situations presented by both the cost-plus and fixed-price contracts. Should it become necessary to end a contract in which there are no provisions for termination, it will be possible for those who hold the contracts to adjust their rights by the provisions covering contracts in Supply Circular No. 88 issued by the Director of Purchase, Storage and Traffic, dated Sept. 17, 1918.

Other provisions for adjustment of contracts are possible through the appointment of a special war department board mentioned elsewhere on this page, but Mr. Baruch in his statement expresses the opinion that existing conditions will require the continuation of a large amount of war contracts.

STATEMENT BY CHAIRMAN BARUCH

"As the demand for raw materials is lessened," the statement continues, "by the reduction of war requirements, the raw materials so made available will be released and allocated by the War Industries Board, for use in supplying civilian and export demands, which have been held in check during the war. In addition to the ordinary commercial requirements, there will be a heavy flow of materials thus released to supply the demand for the great reconstructional work required by the European countries.

"At the same time there is to be a gradual lifting of the restrictions and curtailments that have been imposed upon industry by the exigency of the war, so as to allow as promptly as possible free flow of all supplies into peace channels.

"The War Industries Board will continue to exercise its functions until the peace treaty is signed, to the end that the readjustment of the matters on which it has been acting may be made in as orderly a manner as possible.

"A committee named by the President has been and is now at work to devise the best mechanism of bringing about the adjustments from a war to a peace basis. Its report may take the form of suggested legislation."

W. S. Gifford Resigns From National Defense Council

Walter S. Gifford, until recently director of the Council of National Defense, has been appointed controller of the American Telephone and Telegraph Co., and has entered upon his new duties. Mr. Gifford was formerly chief statistician of the American Telephone and Telegraph Co., and his services were lent by that company, at the request of the Secretary of War, to assist in the organization of the Council of National Defense.

In accepting Mr. Gifford's resignation, the Secretary of War expressed appreciation of the services rendered by Mr. Gifford and the helpful and considerable pride he took in the organization and development of the Council of National Defense. Mr. Baker also expressed his regrets at Mr. Gifford's departure.

BUSINESS NOTES

The Chicago Pneumatic Tool Co. announces the appointment of A. M. Brown as district manager of sales, 1740 Market St., Philadelphia, succeeding G. A. Barden, who remains in Philadelphia as sales representative for the company. For some time past Mr. Brown has been in the New York offices of the company as assistant manager of the compressor sales division.

E. P. Ballou & Co., export freight contractors of New York City, will open offices in Seattle, with J. H. Simmons in charge.

The J. W. McMurry Contracting Co., railroad and bridge contractors, Kansas City, reports its removal to new offices at 511 Railway Exchange Building, Kansas City, Mo.

TRADE PUBLICATIONS

The Brown Hoisting Machinery Co., Cleveland, Ohio, has issued catalogue D-1919, with half-tone illustrations of tram rails, trolleys, electric hoists, overhead traveling cranes, crabs, winches and portable floor cranes.

The labor turnover problem is treated in a 23-p. pamphlet entitled "Reducing Your Labor Turnover," published by the Industrial Housing Co., 405 Lexington Ave., New York City.

The Portable Power Saw Co., 247 Railway Exchange Building, Chicago, has issued an illustrated pamphlet describing the "New Portable Power Saw."